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AMERICAN POTASH INSTITUTE, INC.

INVESTMENT BUILDING **WASHINGTON, D. C.**

Better Crops with PLANT FOOD

The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*
J. D. ROMAINE, *Chief Agronomist*
Editorial Office: Investment Bldg., Washington, D. C.

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Better Crops with PLANT FOOD

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VOL. XXIV WASHINGTON, D. C., MAY 1940 No. 5

New fashions & folks
but the same ole—

Spring in Our Town

Jeff McDermid

LIVING a sequestered life in the provinces, I have just seen Thornton Wilder's folk play, "Our Town," for the first time. Some collegiate boys and girls did the moving little drama for us, or else our home folks would probably have had to be contented with more continued radio serials by the suds and soap companies for artistic refreshment.

Readers are probably more or less familiar with the theme of this Pulitzer prize play, a three-act picture of New Hampshire Americanism, in which the chief departures from standard theatricals lie in the continuous spoken narrative and the absence of painted scenery or props and fixtures. It leaves one free to insert his own native hills for the cliffs of Conway and to stretch out his own village main street as a sort of mental back-drop.

It seems superfluous to tell the story, because in fact there is no regular plot unfolded, no harsh villain to hiss, and no New England snow storm for the hero to buffet against when he redeems the mortgage. On the contrary, the sketch pictures the routine of simple living in a rustic neighborhood whose characters never attain great worldly dignity or honors save those which relate to love, parenthood, daily breadwinning, and inescapable bereavement.

If I mistake not, Mr. Wilder expected those who saw the play to draw their own moral from it, just as they are obliged to envision the cottage gardens and ancient tombstones whose actual presence only voice and gesture proclaimed. To that end I have taken out my own heart throb from the variety

of homely suggestions put forth by this round of humble living.

Maybe it is the same treasure-truth that the playwright really wants to emphasize, but of this I am unaware. At any rate, my best remembrance of it is just an echo of old thoughts coming at odd moments when I am relaxed enough and carefree enough to dwell on my youth and family life and home, old chums long missed and faithful dogs who trot after me on barefoot days which cannot dawn again.

I suspect that New York audiences are more than half made up of folks who used to ramble on wooden sidewalks along elm-shaded main streets, or walk home with some nice girl who was studious enough for two and took delight in exchanging the right arithmetic answers for earnest but awkward compliments. Therefore, I presume that a good many bluff and blasé city slickers pulled down their fedoras when they stumbled out of the theater so nobody would catch them with wet eyelashes.

NEVERTHELESS, I believe that the real test of this Wilder drama comes when it is staged right out where women do their own housework and men mow their own lawns, and where the milkman knows you well enough to ask about the baby or be invited to the wedding.

That means you are bound to enjoy a fine evening, sitting alongside the little minister maybe, or the country doctor, who puts more on the books than he does in the bank. It means that you can nudge your wife with your persistent elbow or steal a glance at her to see if she, too, can see the sycamore and smell the heliotrope.

At first it rather surprised me to find this author dealing so deftly with this particular provincial theme. Somehow, I had not imagined the author of The Bridge of San Luis Rey writing anything lying in the purview of Booth Tarkington, Sinclair Lewis, Eddie Guest, or Bob Burns. But that only goes to show once more that if a fellow lives even for a boyhood interval out among the proletariat, he can't be entirely weaned by Park Avenue, Rio de Janeiro, Leicester Square, or Hongkong. There must be something vital in the atmosphere of our best American villages, despite the fact so many boys quit them early and leave many hope chests unfilled.

It's a play that you or I should have had the nerve to tackle, instead of letting some expatriate do something for us that we ought to be able to handle easily—with all our years of furnace tending, baby raising, and grocery bills. But no, we missed the cue and forgot our lines, I guess. Yet let's be glad somebody set these things down so we can watch actors do it or read a borrowed copy from the library.

I SAID before that this queer play got me all stirred up again about the old town and the folks I saw nearly every day without half appreciating them. It's all in the mind's eye, however, because that delightful human scenery doesn't exist any longer in the town we knew so well. You go up there and stand gawking around on the old drug-store corner or hang around the post-office hoping a girl or a fellow will come along and holler at you with those old grins and nicknames.

But I'm saying right here you are bound to feel foolish and pretty lonesome before the first hour is up. Not one face in ten seems familiar, and the girls you graduated with are at home cooking dandelion greens or sewing spring prints for their youngsters; and maybe if one of them does come along you wouldn't know her for the matronly dame she has grown to be. Then you think she thinks you're trying to flirt with her daughter; but *she* doesn't, because she knows you look older than she does by a mile. As for the elders who you looked up to as civic pace-makers in former times, all you can do about them is to take a solemn stroll among the marble epitaphs.

Maybe if I had all the mysticism of Mr. Wilder like he puts into his graveyard scene, I could stop at the old timers' tomb and have a word with them in a one-sided way. But one must be circumspect about such carryings-on in the home-town burial ground, because it's awful easy to get stories started that reflect on one's sanity. You can be ornery and mean, or vote the wrong ticket, and get by fairly well; but once they think you're "teched

in the head," all the old reminiscences you can conjure up won't get you invited in for strawberry shortcake.

Suppose instead that you just whisper under your breath to the old citizens beneath the bluegrass, being careful not to gesture or mutter when the sexton begins to water that Iris bed over near Banker Bean's mausoleum.

It would be nice to remind old Shaver, the corner grocer of the Nineties, how good his licorice drops tasted on father's pay days; and how much your mother appreciated not being dunned for money, when your dad was out of work nearly a year.

Then it would be pleasant to chat awhile over the mound where the worshipful parson lies, telling him he did lots of folks a good turn when he performed your marriage rites; and that you forgive him for choosing long texts on stifling days and keeping Sunday dinners waiting, and baptizing folks with a complete ducking rather than a light sprinkling.

Or you might lay a mental wreath on the sod where Kate Maloney is sleeping. Ease her rest by thinking what a noble example she made, taking care of her old folks in a town where the only honest labor a girl got was sewing and washing clothes and maid service—which leaves one a poor chance, to be sure, for primping and beau-catching. And she still stays near her parents, ready to help Gabriel shine up his trumpet with polish on the Bright Day Ahead!

THEN, too, you might as well linger at the willow to say things to Loony Lucy, the town's mental wreck. You can say that she didn't live in vain either, because lots of simple folk got a Pharisee's comfort out of observing that others were born worse off than they; and poor Lucy walked her heels off pushing baby carriages. So after all, she deserves as much credit as a pet horse at least.

Likewise, believe it or not, you can spend an interval at Lawyer Rose's eternal abode. You can thank him for sound advice after office hours and for refusing to accept cases from rascals. To his kindly wife beside him, you can repeat how much the teen-age boys of your generation liked the way she fixed up the basement for a gymnasium in those dark ages before they had Boy Scouts, Y. M. C. A. rooms, and high school coaches, and how you rough youngsters sometimes almost forgot that she did it in memory of her son who died down in Cuba.

At last you meander over to the greensward where your own family must hold its reunions forever, and it suddenly occurs to you that your father

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Potash Deficiency In New England

By T. E. Odland

Agronomist, Agricultural Experiment Station, Kingston, Rhode Island

SOILS of New England are generally deficient in potash. It is necessary to supply crops with this highly necessary plant food, either through commercial fertilizers or farm manure, in order to produce satisfactory yields of good quality. Some crops need more potash than others, and some soils are more deficient in this element than other soils. The question that faces the grower is how much potash is needed to produce the most satisfactory results on a given soil with the crops that he is growing, and in what manner and form to supply this potash most efficiently.

No satisfactory substitute for actual field trials in answering these questions has yet been found. Soil tests are helpful in many instances, but taken alone cannot give enough information. The same is true of tests with growing plants in pots filled with different soils. A field test is needed to confirm findings secured in chemical and pot tests. It is not possible for experiment station workers to make tests of fertilizer requirements on all crops and on all types of soil in a State or region. The usual method is to conduct such tests on a few of the more important crops on some of the chief soil types and under a system of crop rotation or form of management that as nearly as possible approaches common practices.

The results obtained in such tests have provided much information useful to growers on their own farms. Often this information has solved difficulties of long standing, and better crops of better quality have resulted. Occasionally a case will show up where things seem not to work out the way they apparently should. Usually a more careful study of the particular circumstances will reveal the cause, and proper correction can be suggested.

The Rhode Island Agricultural Ex-

Spinach on potash experiment, 1931. Left, high potash; center, low potash; right, low nitrogen.

periment Station began studies on potash needs of soil and crops soon after the station was established. These tests have been made at many places in the State and on different soil types as well as on the experiment station plats. They all tell the same story—potash is a very important plant-food material, and the soil does not contain enough of it to make the best crops. It must be supplied largely in manure or commercial fertilizer.

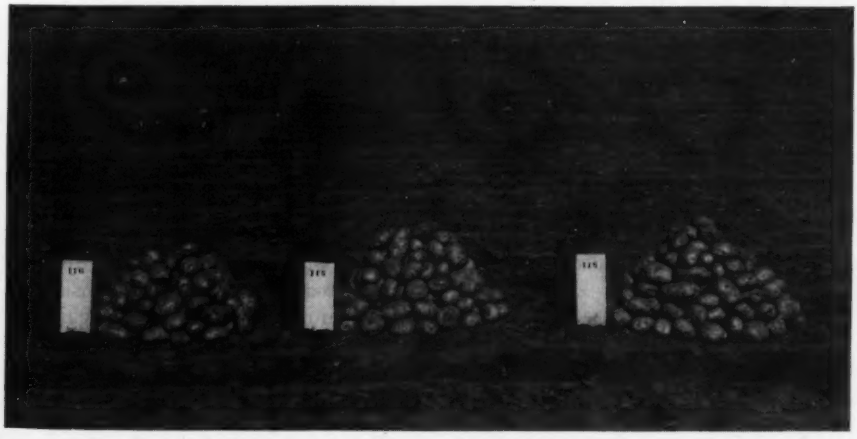
Proper Use of Fertilizer

Farm manure has long since become too scarce an article in Rhode Island for supplying all the needed potash for our farm and truck crops. It is necessary to turn to commercial fertilizer. How much to use, what form, what are the individual crop needs, and what effect has the soil type on the requirements are then vital questions. With the narrow margin of profit on which nearly all farm crops are produced at present, it is highly necessary that the grower make his fertilizer dollar as efficient and useful as possible. None of our up-to-date farmers question the necessity of using a liberal amount of fertilizer in order to produce satisfactory crops. The question is how much and what kind.

One of the most extensive of the fertilizer tests on potash was begun at the station in 1911. It provided for a comparison of four different potash carriers: kainit, muriate of potash, sulfate of potash, and sulfate of potash-magnesia. It also included a plat receiving no potash and one with double the standard amount of sulfate. The rotation followed has consisted of 2 years of cultivated crops followed by 2 years of hay. Usually a number of cultivated crops were grown the same year by using only a portion of each plat for each crop. When the plats were in hay, the whole area was used for that one crop.

Some time was required to bring the plats which were to receive deficient amounts of potash to a low fertility level. Also, certain changes were made in recent years that seemed justified from the work up to that time. In these comments I will use the results for the 15-year period, 1920 to 1934, inclusive.

One of the plats received no potash in the fertilizer during the first 16 years of the experiment. By this time the yields of all crops were so poor as to be practically failures. It was, therefore, decided to make this a low potash plat and from one-quarter to one-half of the standard amount of potash has been used since that time. The standard plats, on which different carriers of potash were used, received only about



Potatoes on potash experiment, 1939. Left, low potash, 226 bu. per acre; center, medium potash, 264 bu. per acre; right, high potash, 312 bu. per acre.

a half of the amount of potash that is usually considered as sufficient for the crops grown. This was done in order to make sure that, as far as possible, there would not be any surplus over the requirements. For this reason the yields have not been very high on these plats. On one of the plats, twice the amount of potash in the sulfate form was used as on the standard, thus making what has been called an optimum fertilizer plat. All plats were treated alike as far as nitrogen, phosphorus, and muriate was used. The sulfate showed a little higher average yield than the muriate. Doubling the amount of potash in the fertilizer resulted in nearly a 50 per cent increase in yield.

When the potatoes from this experiment were compared for cooking qualities, it was found that the ones from the low potash plat were very soggy and unpalatable. The high potash plat produced by far the most mealy potatoes. There was little difference between various sources in their effect on

TABLE I. YIELDS OF DIFFERENT CROPS WITH DIFFERENT POTASH SOURCES

Crop	Years Grown	Unit	Potash Sources and Yield in Bushels per Acre					
			Low Potash	Kainit	Potash-Magnesia	Muriate	Sulfate	Extra Sulfate
Potatoes	8	Bu. per Acre	115	207	198	215	228	321
Carrots	5	Bu. per Acre	573	840	741	847	681	901
Onions	4	Bu. per Acre	125	310	318	303	299	412
Tomatoes	4	Bu. per Acre	244	486	389	392	414	598
Corn	2	Bu. per Acre	12	60	41	52	54	59
Mangels	4	Tons per Acre	8.2	29.8	15.9	19.1	16.4	25.2
Hay	5	Tons per Acre	1.61	2.50	2.43	2.31	2.31	3.18

Fertilizer applications in recent years:

Cultivated crops..... 1 ton 4–8–2, 4–8–5, and 4–8–10
Hay..... ½ ton 4–8–2, 4–8–4, and 4–8–8

lime applications were concerned. No manure has been used at any time.

The results obtained on the experiment have given some very interesting facts on the value of different potash carriers for farm crops and on the relative response of crops to potash fertilization. Some of these results I would like to discuss briefly.

During the 15-year period from 1920 to 1934, a total of eight crops of potatoes, five of mixed hay, five of carrots, four of mangels, four of tomatoes, four of onions, and two of corn were among the crops included. The average yields on four of the treatments for this period are shown in Table I.

Potatoes, as may be seen from this table, were grown in 8 years out of the 15. Where none or very little potash was used, the yield was only 115 bushels per acre as an average. There was not much difference in average yields whether kainit, potash-magnesia, or quality. Although the statement is often seen that the sulfate as a source of potash produces a better quality of potatoes than muriate, this was not the case in these tests.

Carrots are not as sensitive to variations in potash as are most vegetable crops. A fair yield was obtained even with a fertilizer very low in potash. However, as the potash was increased, better yields and better shaped carrots were obtained. Carrots seemed to prefer the muriate and kainit forms.

The yields of onions were doubled by using a fertilizer with the standard amount of potash. When the potash was increased to what was considered an optimum, the yields were again increased by one-third over the standard. Little difference in either yield or quality of onions was found as a result of the different potash sources used.

Tomatoes responded well to increases of potash over the minimum applied.

The standard application resulted in about two-thirds more tomatoes than where the minimum was applied, while the optimum application resulted in nearly another 50 per cent increase. The size and general quality of the tomatoes improved with the increase in potash in the fertilizer. Kainit for some reason showed to better advantage for this crop than any of the other sources.

Corn was only included during 2 years of the test. Since the amount of fertilizer used on the other cultivated crops is too high for corn, it could not be expected that the maximum amount of potash would result in any marked increase in the yield. No potash was applied to the plat designated as low potash during the 2 years that corn was grown. The average yield was only 12 bushels per acre. When the standard amount was used it resulted in more than four times this yield. Increasing the amount of potash in the fertilizer over the standard amount resulted in very little increase in yield.

Mangel yields were doubled by increasing the potash to the standard amount, and they also benefited by the extra amount. This crop preferred the potash when supplied as kainit. For some reason the potash in kainit was nearly twice as effective as in the sulfate and considerably better than in the muriate.

Mixed hay was grown during 5 years of this period. For 2 years the mixture consisted of legumes and grasses, and the other 3 years of timothy and red top only. When legumes were included, the yields on the standard plats were about double that on the low potash and about three times as high on the high potash plat. The response to potash on the grasses-only plat was much less. Practically no alfalfa or clover was obtained on the low potash plat. The best stand of legumes was secured on the high potash plat. In this case, therefore, the increase in yield was not the only benefit derived. Due to the increased clover and alfalfa resulting from the additional potash, the hay was on the average more than twice as high in protein content on the high potash as on the low potash plat. There was no great difference in the results obtained with the different sources of potash for the hay crops.

The results obtained in this experiment show clearly the necessity for an adequate potash fertilization for these crops. Legumes and potatoes, of the more common crops grown in this region, show the greatest returns from a

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Onions on potash experiment, 1939. Left, low potash, 206 bu. per acre; center, medium potash, 393 bu. per acre; right, high potash, 526 bu. per acre.

This type of legume growth is dependent upon abundant supplies of lime, phosphate, and potash in the soil.

Legumes Are Making a Grassland Possible

By F. V. Burcalow

Extension Agronomist, College of Agriculture, Madison, Wisconsin

THE trend in agricultural thinking in many parts of the country is towards a grassland agriculture—a type of farming in which grass is not just incidental and taken for granted, but where it receives as much attention and consideration as any of our harvested crops with respect to management, fertilization, and improved varieties. This trend towards more acres in grass will be effective for a long period of years. It will directly affect the production of livestock and dairy products. The use of roughages will increase, and greater emphasis will be placed on roughages of high quality. Improved pasturage, better hay, and superior silages will result. Total feed production may be less, but the cost of production will be lowered.

A shift to a grassland type of farming is an expression of the trend from intensive to more extensive farming. While the activities of various Federal agencies are hastening the shift, it is not entirely a result of these agencies, but rather it is the result of the accumulative forces of research and education which have prevailed during the last 50 years. For soil fertility and even the soil itself to be maintained and kept in place, intensive farming, especially on hillsides, must be replaced by a less intensive type; grasslands must be improved; eroded cropland must be returned to grass; and rotations must be lengthened.

Approximately one-half of the farmland in Wisconsin at the present time is listed as pasture. Conservative estimates indicate that 10 to 20 per cent of the land now cropped should be converted to pasture land.

Fortunately, all of this land that is to be devoted to grazing need not be thought of as being composed entirely of shallow-rooted grasses such as blue

grass. With grass and grass alone, the outlook for the future is not too optimistic. While grasses have great survival value, they are commonly unproductive and unpalatable during dry, hot weather in the north central region.

The hope of a grassland type of agriculture in regions with climatic conditions such as generally prevail in the north central States will depend upon the establishment of deep-rooted, drouth-resistant legumes in association with grasses. Where we speak of grasslands we should include both grasses and legumes in combination.

The possibility and the feasibility of establishing legumes on old sods have been demonstrated on hundreds of Wisconsin farms during the last 12 years. Wisconsin farmers now appreciate the extent to which the fertility of their pasture soils has been lowered

Potash made the difference here. Foreground received lime and phosphate; background, lime, phosphate, and potash.

through the sale of livestock and dairy products produced from these pastures over a period of years. Many pounds of lime, phosphate, potash, and particularly nitrogen have been removed in this manner. In many cases the removal of the minerals, lime, phosphate, and potash, accounts for the disappearance of white clover and the decreased production and palatability. Evidence of such lowered fertility is made apparent by weed encroachments, particularly with poor management and in years of drought.

Unless soils are extremely deficient, top-dressing permanent pastures with lime, phosphate, and potash gives very little in the way of immediate returns from shallow-rooted grasses such as blue grass. Particularly is this true under conditions of limited moisture and high temperatures. However, the value of these pastures may be greatly enhanced if, after the needed lime, phosphate, and potash have been applied, the sod is scarified to work in the fertilizer and to prepare a seed bed, and the pasture reseeded to a mixture containing deep-rooted legumes, such as a mixture of sweet clover and red clover, or alfalfa and red clover. Under these conditions the legumes benefit from the lime, phosphate, and potash, and the grass in turn benefits from the legumes which make nitrogen available for use by the grasses.

Restore Soil Fertility

The conversion of eroded cropland to grass-legume mixtures is dependent upon restoration of the supplies of lime, phosphate, and potash in worn-out soils. A few years ago when we tested the soil for acidity only, lime was thought to be the only limiting factor. Later, a lime-phosphate combination was thought to be the answer. Now it has been definitely demonstrated that potash is many times a limiting factor. The extensive soil-testing program now under way in Wisconsin, by which the soil needs for lime, phosphate, and potash are determined, is taking the guesswork out of our grassland improvement. In many cases where the desired results were not obtained with applications of lime and phosphate, soil tests and demonstrations show that potash was needed in addition. Analyses of several thousand soil samples from old pastures show that 90 per cent of them need lime, 75 per cent need phosphate, and 60 per cent need potash.

A grass-legume mixture provides a palatable feed high in mineral, vitamin, and nutritive value that may be used for pasture, hay, or silage. It provides economical production in keeping with principles of proper land use and soil conservation. It is nature's best protec-

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Borax as a Control[1] For Heart Rot Of Sugar Beets

By R. L. Cook[2]

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HEART rot of sugar beets was first attributed to an insufficient supply of soil boron by Brandenburg (1) of Germany in 1931. For years prior to that date the disorder had been classed as a disease, and many attempts had been made among European investigators to isolate the causative organism.

Since Brandenburg's experiments were reported, other workers both in Europe and in this country have verified his findings that heart rot is caused by a deficiency of boron. Kotila and Coons (4) reported the presence of heart rot in Michigan beets in 1935. A study of symptoms of the disorder and the results of preliminary field surveys and experiments were reported by the author (2) in 1937. Since that date many Michigan farmers have learned to recognize heart rot, and some state that they have experienced losses from this cause for many years. It is the purpose of this paper to report further progress in the experiments performed to determine the effectiveness of borax as a control for heart rot of sugar beets.

For the benefit of those not acquainted with the breakdown of sugar beet tissue caused by an insufficient supply of boron, it seems advisable to briefly review the subject from the standpoint of soil characteristics on which the disorder occurs and plant symptoms exhibited.

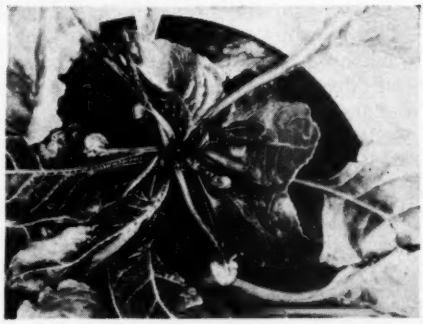

Fig. 1.—Darkened, cross-checked petioles and twisted unsymmetrical leaves indicate boron deficiency. This beet was produced in the greenhouse without borax in Thomas sandy loam soil.

The results of surveys conducted during the last 3 years show that heart rot occurs more often on the rolling Miami loam, silt loam, and clay loam soils than on the level Brookston soils of similar texture. Furthermore, it has been found that occurrence on the rolling soils is usually confined to the higher places in the fields. On the level soils, where sugar beets are commonly grown in Michigan, signs of boron deficiency occur most often in areas of lighter texture and higher organic matter content, or in areas underlaid by sand and gravel fairly close to the surface.

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[1] Contribution from the Soils Section, Michigan State College, East Lansing, Michigan. Authorized for publication by the Director as Journal Article No. 422 n.s. of the Michigan Agricultural Experiment Station.

[2] Research Assistant in Soils.

Acknowledgment is made to J. F. Davis and G. R. Muhr for assistance in the experimental work reported in this paper.

These places of heart rot occurrence indicate that leaching has some influence on the supply of boron in the soil. Chemical tests, however, have failed to reveal low percentages of boron in the areas where sugar beets have suffered from lack of the element. This is an indication that leaching has the effect of quickly removing the available boron as it is released from the minerals by weathering, and that it is not effective in rapidly reducing the total boron content of the soil. This seems to be a logical conclusion, because boron minerals weather slowly.

Chemical tests show that heart rot occurs more often on alkaline than on acid soils and that a positive correlation exists between heart rot occurrence and the active calcium content of the soil. The results of these experiments have been recently presented for publication (3).

The first signs of heart rot appear in July or early August, in extreme cases, and later in areas where the supply of available boron is somewhat greater. Leaf symptoms are first noticed. These are illustrated by the plants in the greenhouse pot cultures shown in Figs. 1 and 2. The blackened and checked petioles are positive signs of heart rot. Shortened and twisted petioles and large numbers of small leaves are also reliable signs.

An insufficient supply of boron results in a breakdown of the tissue in certain portions of the plant. In the sugar beet the death of the growing center of the crown and the production of such beets as shown in Fig. 3 have resulted in the name heart rot. Later in the season some beets send out a large number of leaves from around the edge of the crown. These leaves may die after reaching the stage shown in Fig. 3, or they may continue to grow until harvest time when they practically cover the dead heart.

Fig. 2.—A large number of small leaves, some twisted and abnormally shaped, indicate boron starvation. This beet was also produced on Thomas sandy loam soil without borax. All beets which received borax in this soil were normal.

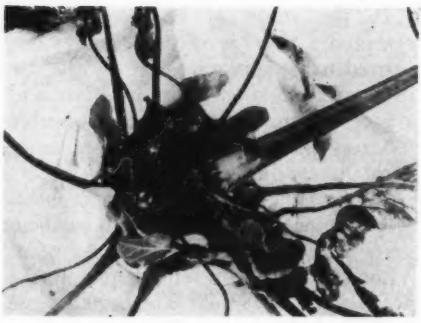


Fig. 3.—After the fall rains start, new leaves often come out from around the dead heart. These leaves may soon die or may attain full growth, according to the condition of the beet.

All sugar beets suffering from an insufficient supply of boron do not exhibit the same symptoms of deficiency. Some show leaf symptoms only, while others suffer breakdown of the root tissue. The nature of this tissue disintegration is illustrated in Figs. 4 and 5. An entire beet showing a dead heart with numerous, small, twisted leaves and with a side canker on the root is pictured in Fig. 6.

In occasional fields individual beets afflicted with heart rot are found well scattered among healthy beets, but usually the disorder occurs in patches varying in size from a few square yards to an acre or more. One of the large patches in which most of the beets were affected is shown in Fig. 7. In this particular case the soil is an alkaline sandy loam containing 14 per cent organic matter and underlaid by a layer of sand at a shallow depth. These conditions appear to be ideal for the development of heart rot.

In the study of boron deficiency symptoms, the use of pot cultures has proved to be very valuable. By the use of a screened room, without glass and adjacent to the greenhouse, it is possible to grow plants in season under fairly constant conditions.

Plan of Pot Cultures—Sugar beets were grown in 2-gallon, glazed earthenware jars, each filled with 8 kgm. of Thomas sandy loam soil taken from the area shown in Fig. 7. Treatments were replicated six times. Three sugar beet plants were transplanted into each pot soon after emergence from the quartz sand in which the seeds were germinated. The six control pots were then treated with a complete nutrient solution. The effect of copper, manganese, boron, and magnesium on the development of sugar beets on this particular soil was determined by omitting, in turn, each of the elements from the nutrient solution. The effect of doubling each of the first three elements was also studied. The treatments in this experiment are listed in Table 1. The moisture content of all the cultures was kept uniform by frequently bringing them up to weight by additions of distilled water.

Results—As shown by the data presented in Table 1, all the plants grown in cultures without boron were affected with heart rot, while all cultures which received boron in the nutrient solution produced healthy plants. The contrast

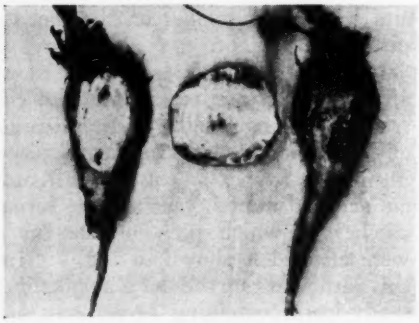


Fig. 4.—Heart rot not only affects the heart of the beet but causes external cankers, as shown by the whole beet, and discolorations similar to those showing in these cross and longitudinal sections.

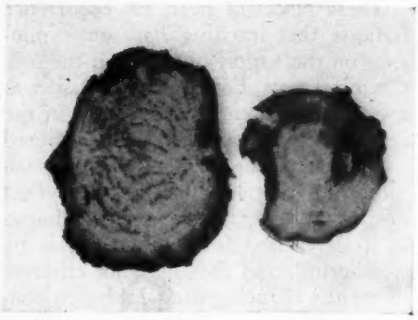


Fig. 5.—Cross sectional slices taken from beets which were almost completely destroyed by heart rot. Even the undiscolored portions of these beets were of light weight and spongy.

in appearance of these cultures is illustrated by those shown in Fig. 8, while the appearance of individual plants suffering from heart rot is illustrated by Figs. 1 and 2. The elimination of other elements from the nutrient solution had no effect on the development of heart rot.

As further indicated by the data presented in Table 1 and by the roots pictured in Fig. 9, boron applied as borax at the rate of 10 pounds per acre increased the yield of roots from 46.7 gms. to 90.4 gms. per pot, and the yield of tops from 109.0 gms. to 131.4 gms. per pot. The sucrose content of the roots was increased from 15.4% to 17.0%. As shown by the analysis of variance, these differences are significant to the 1% point in the case of yields and to the 5% point in the case of sucrose content. No significant differences in yields or sucrose content were obtained by eliminating any other nutrient element or by applying double quantities of any element. In fact, there was a slight indication that 20 pounds of borax per acre actually reduced the yield of roots below the yield obtained as a result of the control treatment.

Before recommendations may be made regarding the field use of such a material as borax, it is necessary to try out the material by means of field experiments. The experiments discussed in this paper were started in 1936 and have been continued since that date.

During the first 2 years, it happened that heart rot did not occur on any of the fields in which the experiments were located, but in 1938 and 1939 better luck was experienced in locating the experiments, and the results of those tests are presented in the following pages.

Plan of Field Experiments—The field experiments were so planned that information would be obtained as to the quantities of borax necessary to control heart rot on different soils and as to the quantities which might be applied without injuring the beets. Quantities of borax ranging from 10 to 80 pounds per acre were applied broadcast and in contact with the seed. In 1939 the heaviest rate of application was made in a band beside the seed. In all of the experiments the beets were uniformly treated with 2-12-6 fertilizer. The borax was applied with the fertilizer. All plats were arranged in randomized blocks with treatments replicated from four to six times.

Effect of Borax on Stand and Yields—Experiments with several crops have shown great variability in the quantity of borax which may be applied without causing injury to germination or decreases in yields. Sugar beets are not easily injured. Stand counts made after the beets were blocked showed that during the 3 years, 1937-8-9, borax applied broadcast at rates up to 80 pounds per acre had no effect on the stand of sugar beets. Stand counts on the broadcast experiments are not presented, but the data presented in Table 2 show that in 1938 yields were not reduced by the heaviest applications of borax.

Experiments were performed on eight fields during the 3 years. The soils varied widely in pH and percentage of organic matter and in texture from sandy loam to silt loam. Further reference to Table 2 reveals a trend toward increased yields as a result of borax applications. The heaviest application on the Miami soil and the 20 to 80-pound applications on the Napanee soil apparently increased the yields by 1.0 to 1.1 tons per acre, and while according to the analysis these increases were not significant, they come so near significance that it is believed significance would have resulted if the errors of the experiment could have been better controlled.

Where borax was applied in the row, significant differences in stand were obtained. As shown by the data presented in Table 3, as much as 40 pounds of borax were applied with the seed on Brookston soil in 1938 without injury to stand, but on Napanee and Miami the 40-pound application significantly reduced the stand. In no case was there an injury as a result of the 20-pound application. The weather conditions during the season of 1938 were favorable for the growth of sugar beets. There was plenty of moisture during the early part of the growing season, which probably accounts for the fact that injuries from high applications of borax were rather slight.

During the season of 1939 the rainfall varied considerably in different

Fig. 6.—This beet taken from the field at harvest time is characteristic of those suffering from lack of boron. Note the canker at the left of the root, the dead heart, and the large number of small, deformed leaves.

parts of the sugar beet area. The Miami soil was very dry for a considerable period after planting. This is reflected in the stand counts recorded in Table 4. All applications of borax caused significant reductions in stand on this soil. On the Napanee soil only the 80-pound contact treatment injured the stand. The good stands obtained from the 20 and 10-pound treatments are shown in Fig. 10. On the Thomas soil injury resulted from applications of 40 pounds per acre. On the Onaway and Posen soils, located in the Upper Peninsula of Michigan, significant injury occurred with the 20-pound application on the Onaway soil. These 1939 data illustrate very nicely the variability in results which may be obtained on different soils during the same season.

It is interesting to note the difference between the stand counts obtained from contact and side band applications. On two of the soils, 80 pounds of borax in a band 1½ inches to the side of and 1¾ inches below the seed had no effect on stand, while the same quantity of borax with the seed reduced the stand to about one-third that of the control. It seems that the advisability of side band placement of fertilizer will be greater when borax is included in the mixtures.

As shown by the data presented in Tables 5 and 6, borax applied in the row reduced the yields in cases where the applications were heavy. In general, the reductions in yields corresponded to injuries in stand. There were exceptions to this in 1939, when the 10 and 20-pound applications on the Miami soil reduced the stand but did not significantly lower the yields. The same was true in the case of the 20-pound application on the Onaway soil. On the Thomas soil a significant drop in yield occurred as a result of the 20-pound application, although the reduction in stand was not significant.

There were no significant increases in yield as a result of applying borax in the row. On some of the fields increases in yield did occur with the lighter applications. On the Onaway and Posen soils in 1939 heart rot was quite prevalent, and in both cases, as shown by the data in Table 6, the areas treated with 10 pounds of borax yielded more than did the control areas, but the increases

(*Turn to page* 39)

Fig. 7.—An area on Thomas sandy loam soil near Unionville where practically all the beets showed heart rot symptoms. This is an alkaline soil, high in organic matter content and underlaid in this spot by a layer of coarse sand.

Cotton Is Improved By One-variety Plan

By E. C. Westbrook

Agronomist, Agricultural Extension Service, Athens, Georgia, and Agent for the U. S. Bureau of Plant Industry

FOR THE period 1932-1939 there was a large increase in the production of cotton which has a staple length of 1 inch to 1-3/32 inches. There also was a very marked reduction in the production of cotton with 7/8 and 29/32-inch staple.

In most parts of the cotton belt there appears to be no good reason for growing cotton with a staple shorter than 15/16 inch. Most manufacturers who are using cotton shorter than that will tell you that the only reason for using it is because they can buy it cheaper than they can buy longer cotton. In the mill 7/8-inch cottons do not work as well as longer lengths. When manufacturers feel assured of an adequate supply of 15/16-inch and longer cotton at what they consider economical prices, the demand for 7/8-inch cottons will continue to decline. Apparently that time has arrived for the majority of our manufacturers.

In recent years a number of mills have shifted from 7/8-inch to 1-inch cotton. The trend apparently is strong in that direction. However, additional time will be required for many mills to install long-draft spinning machinery.

Changes in the production of cotton of different staple lengths in some of the individual States have been considerably greater than the change for the cotton belt as a whole. In Georgia in 1938 only 31.2 per cent of the crop was shorter than 15/16, as compared with 73.8 per cent in 1932. In the northern half of Georgia only 12 per cent of the 1938 crop was shorter than 15/16. Many other States have undergone great changes in the production of cotton of different staple lengths. In every case there has been a reduction in the amount of 7/8-inch cotton.

One thing which is interesting to note is that there has been very little change over a long period of years in the production of 15/16-inch cotton. Apparently there are not many breeders working on cottons of that staple length, despite the fact that there is a good demand for cotton of that length.

Immediate Advantages

The U. S. Bureau of Plant Industry and the Agricultural Extension Service in the Cotton States came into the picture in 1931 with the plan of cotton improvement, which they called the *single variety* or *one-variety community plan*. From the beginning this plan was favorably received by farmers, ginners, cotton manufacturers, cotton buyers, and others, and has had a very rapid development. The one-variety plan made it possible to produce and distribute large quantities of pure seed of the best varieties at very reasonable cost to farmers. It reduced mixing of varieties at the gin and in the field, made the work of cotton breeders available to a much larger number of farmers, and extended the value of the good varieties over a much longer period. Many communities have developed a reputation for growing quality cotton, which has enabled them to sell their cotton at a premium. It has also made

it possible for communities to produce quality cotton in sufficient quantity to fill mill orders to best advantage.

After 1931 the number of one-variety communities increased rapidly. For most years since 1931, cotton with 1-inch and longer staple has sold for satisfactory premiums over ⅞-inch cotton. Better and improved varieties of 1-inch and longer cottons have been developed. There has been a general appeal to growers to improve the quality of their cotton so as to meet requirements of domestic mills to better advantage. In addition growers were told that if they grew only cotton of high quality it would enable them to meet competition with foreign cottons more successfully.

Well-managed Program

Just how well cotton farmers responded to the one-variety community plan of growing cotton is indicated in a report prepared by C. B. Doyle of the U. S. Bureau of Plant Industry. According to Mr. Doyle's report for 1938, there were 1,044 organized communities in 427 counties in 14 States. These communities planted 2,205,189 acres of one-variety cotton and produced 1,465,543 bales. It is estimated that the one-variety communities had a membership in 1938 of 100,000 farmers. In 1935 there were only 343 one-variety communities.

In addition to the improved cotton planted in organized communities, there has been a large acreage planted outside one-variety communities with the same improved varieties. This expansion has come about because of the favorable publicity given through the one-variety program, and because seed were made available in large quantities and at reasonable cost.

According to my knowledge, the response to the one-variety or the community plan of growing cotton has been much greater than to any other plan of cotton improvement. The ginner is still the key man in the well-defined gin community. His wholehearted cooperation is necessary to the successful operation of the one-variety project. Establishment of county-wide or even larger one-variety areas has made it possible to overcome, to some degree, lack of interest on the part of certain ginners.

Some ginners have helped a great deal to solve the problem of seed re-

This community had the Government free-classing service. Left to right: E. C. Westbrook, Extension Agronomist; J. H. Beasley, One-variety ginner; T. P. Holbrook, President, Shoal Creek One-variety Community; and E. H. Thomas, County Agent, Hart County.

Weighing one-variety cotton in Georgia at the end of the day.

newal. They have placed breeder seed with picked farmers who multiply the seed and sell them to the ginners at small premiums above oil mill prices. Many ginners clean the seed and in some cases delint and treat them with Ceresan. The seed are then ready for distribution in the community at a fair price. The surplus, if any, goes to other communities. The old plan of farmers buying enough breeder seed each year for a seed patch is still recommended, but is followed by only a small percentage of the farmers.

Judicious Use of Services

Farmers and communities have been requested to keep their minds on the main objective—"Production of quality cotton in quantity." They have been warned against making the one-variety project a seed-selling business. In Georgia the warning has been heeded. The price of planting seed other than breeder seed has been cheap, usually one for one and one-half oil mill price basis. This has kept the price of good seed within the reach of everybody.

Beginning with 1938 the Smith-Doxey Service has made free classification and marketing news service available to farmers in one-variety communities. These services should add momentum to the production of better quality cotton.

The variation in yield of any variety from year to year sometimes causes farmers to be dissatisfied the first year with the new variety, especially if the first year the community starts out on a new variety it runs into conditions which are unfavorable for normal yields. In such cases many farmers attribute the smaller yields to the new seed.

One has only to examine variety tests to see that the best of varieties may yield 600 pounds of lint per acre one year, and the next year the yield may be only 300 pounds. When the initial effort in a one-variety community runs into adverse seasons, careful management is sometimes necessary to prevent it going on the rocks. Adverse seasons may also "do things" to other recommendations which may be perfectly sound. For example, with a very favorable season a farmer may make a bale of cotton per acre with a nominal application of one fertilizer, and the next

(*Turn to page* 35)

Enough Nitrogen Everywhere Except in the Soil

By George D. Scarseth

Soil Chemist, Purdue Agricultural Experiment Station, Lafayette, Indiana

¶ *Fourth of a series of practical articles dealing with the principles of soil fertility.*

IF MAN could continue to move to newly cleared woodland every time the fertility of the soil became depleted, he would not need to be concerned about the possible lack of available fixed nitrogen in the soil. When soils lose nearly all of their native organic matter, crop production problems become numerous. On all well-drained and well-aerated soils, deficiencies of nitrogen will always develop unless it is supplied by legume crops, by nitrogen-fixing bacteria, or by nitrogenous manures and/or nitrogen-carrying fertilizers.

Nitrogen Fixation Makes Gaseous Nitrogen Useful to Plants. This situation regarding nitrogen is unique when compared with that of other plant foods. There are about 75 million pounds of nitrogen in the air above every acre of land and sea, but to most plants it is as useless in this gaseous form as sea-water is to a thirsty man. Just as salty water must be distilled to obtain suitable drinking water, the atmospheric nitrogen must be combined with oxygen, carbon, and hydrogen, before it is of any use to growing plants. This process of obtaining useful nitrogen is called "nitrogen fixation" and is not to be confused with the soil fixation of phosphates.

Were it not for the dilution of the oxygen in the air by inactive nitrogen

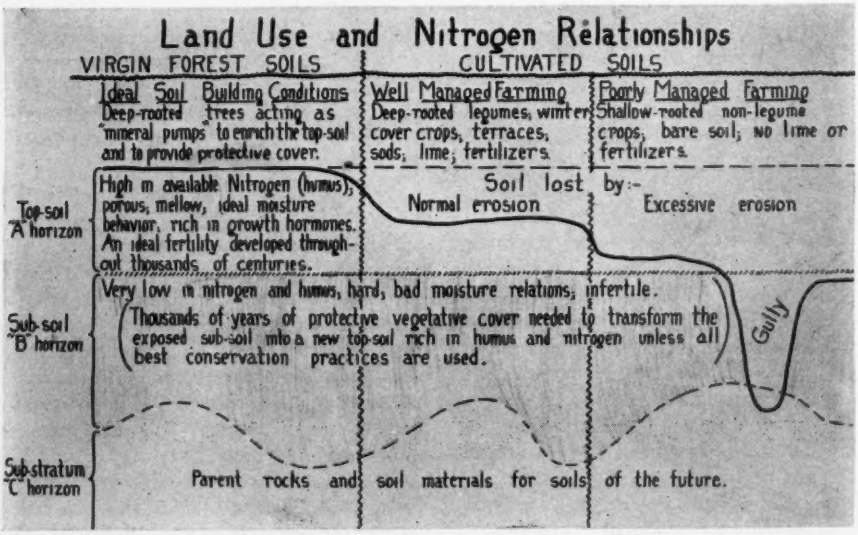

Land Use and Nitrogen Relationships
VIRGIN FOREST SOILS
CULTIVATED SOILS
Ideal Soil Building Conditions
Deep-rooted trees acting as mineral pumps to enrich the top-soil and to provide protective cover.
Well Managed Farming
Deep-rooted legumes, winter cover crops, terraces, sods, lime, fertilizers.
Poorly Managed Farming
Shallow-rooted non-legume crops, bare soil, no lime or fertilizers.
Top-soil A horizon
High in available Nitrogen (humus), porous, mellow, ideal moisture behavior, rich in growth hormones. An ideal fertility developed throughout thousands of centuries.
Soil lost by:-
Normal erosion
Excessive erosion
Sub-soil B horizon
Very low in nitrogen and humus, hard, bad moisture relations, infertile.
Thousands of years of protective vegetative cover needed to transform the exposed sub-soil into a new top-soil rich in humus and nitrogen unless all best conservation practices are used.
Gully
Sub-stratum C horizon
Parent rocks and soil materials for soils of the future.

Fig. 1.—The relationship between a typical virgin forest soil and farming practices. The nearer the cultivated soils can be maintained to conditions prevailing under the virgin conditions the better the farming practices.

(air = about 20% oxygen and 80% nitrogen), plant and animal life would soon be oxidized or burned to ashes. On the other hand, were it not for the processes of fixation of the nitrogen, plants and animals would starve for it, even though constantly bathed in it in a useless form. It is an engrossing thought to realize that nitrogen is another vital link in organic nature.

The first fixed nitrogen was probably made by lightning flashes long before life appeared on the earth. Eventually, single-celled green plants (algae), bacteria, slime moulds, and higher plants became more and more developed, until some became host plants for nitrogen-fixing bacteria. Legume plants are among the most primitive of our higher plants and have long served as hosts for these nitrogen-fixing organisms.

Nature Fixed Nitrogen and Developed Rich Virgin Soils. Wherever the temperatures and rainfalls were suitable, forests have developed. The sizes and types of trees became largely a function of the amount of nitrogen made available by these various processes of fixation. Forests became the fields for man to exploit and to use for his own development. He has also been able to explore the world for natural deposits of fixed nitrogen (nitrates) and has succeeded in making technical improvements on nature's processes by directing the fixation of nitrogen through the use of legumes, electricity, and heat. All of these efforts, of course, are in the direction of supplementing a diminishing supply of organic matter in the soils, which he must continue to cultivate to grow his food supplies. Soils rich in humus carry an abundance of easily available nitrogen.

Figure 1 illustrates some of these relationships between the nitrogen and humus that existed in virgin forest soils and the effect of certain farming practices on them. It is obvious that poor farming practices result in the farming of the subsoils. They may be very infertile as well as unprofitable. Soil management practices that conserve the ideal virgin conditions in soils as far as possible are best from a long-time view.

Virgin forest soils will have an acidity of about 6.5 to 7.0 pH (nearly neutral in reaction) in the top inch. This is true even though the B horizon (see Fig. 1) or subsoil may be very strongly acid (pH 4.8 to 5.5). Clover failures were rare in Indiana 40 years ago but

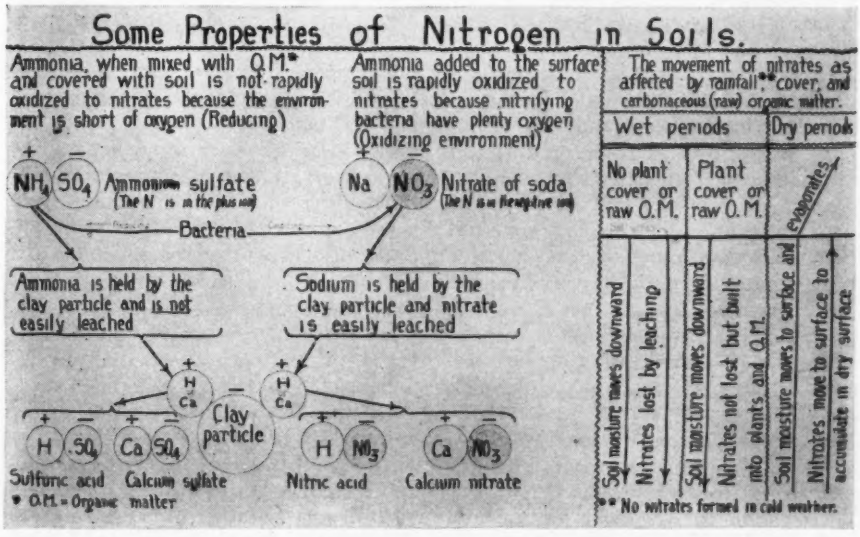

Some Properties of Nitrogen in Soils.
Ammonia, when mixed with O.M.* and covered with soil is not rapidly oxidized to nitrates because the environment is short of oxygen (Reducing)
Ammonia added to the surface soil is rapidly oxidized to nitrates because nitrifying bacteria have plenty oxygen (Oxidizing environment)
NH4 SO4 Ammonium sulfate (The N is in the plus ion)
Na NO3 Nitrate of soda (The N is in the negative ion)
Bacteria
Ammonia is held by the clay particle and is not easily leached
Sodium is held by the clay particle and nitrate is easily leached
H Ca
Clay particle
H SO4 Ca SO4
Sulfuric acid Calcium sulfate
H NO3 Ca NO3
Nitric acid Calcium nitrate
* O.M. = Organic matter
The movement of nitrates as affected by rainfall,** cover, and carbonaceous (raw) organic matter.
Wet periods
Dry periods
No plant cover or raw O.M.
Plant cover or raw O.M.
evaporates
Soil moisture moves downward
Nitrates lost by leaching
Soil moisture moves downward
Nitrates not lost but built into plants and O.M.
Soil moisture moves to surface and
Nitrates move to surface to accumulate in dry surface
** No nitrates formed in cold weather.

Fig. 2.—The diagram shown above illustrates the movement of nitrogen compounds in the soil as affected by placement, organic matter, clay particles, plant cover, and climate.

now are frequent. One of the causes for this is associated with a loss of the original surface, particularly the organic matter and basic nutrients.

Decline in Native Nitrogen Brings New Problems. Climatic factors, as well as those of management, greatly affect the rate of soil deterioration and loss of fertility. In the warm regions of the South (above 55° F. mean annual temperature) where the rainfall is high (50 to 70 inches annually), the native nitrogen supply is lost in a few years of farming. However, in the north central regions where the rainfall is less (25 to 40 inches annually), the native humus and nitrogen has lasted in many places for more than 100 years of farming.

Now that the northern soils are becoming more generally depleted in nitrogen (the southern soils have been depleted nearly from the starting of their cultivation), farmers are looking towards what they can do in supplying crops with plenty of available nitrogen. The problem is relatively simple—either more nitrogen-fixing plants (legumes) must be grown and returned to the soil, or nitrogen-carrying fertilizers must be used.

Because of this need, it is imperative that something be known regarding the behavior of several of these nitrogen carriers when applied to the soil.

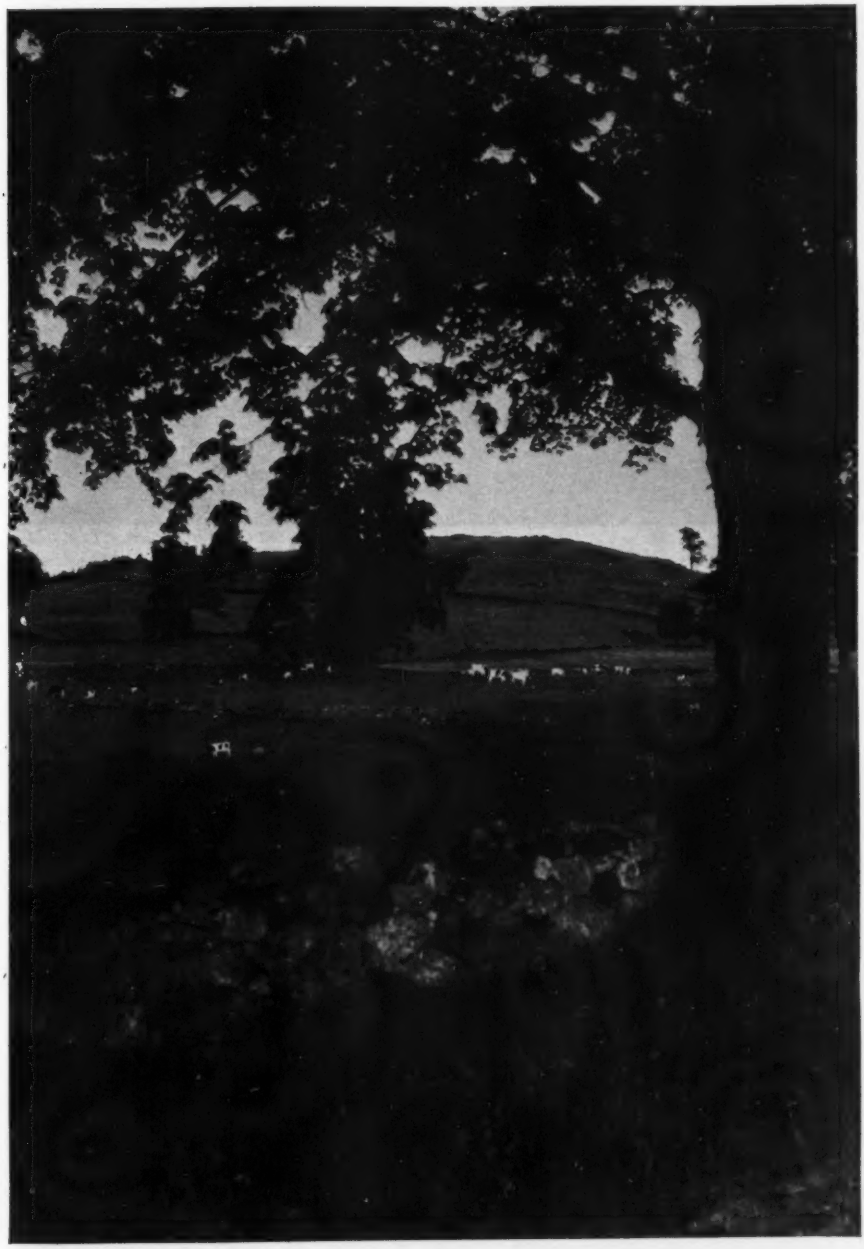
In areas of scanty rainfall during the growing season and with medium heavy soils, it is best to plow under the nitrogen carriers. The ammonium-forming fertilizers, such as calcium cyanamide, ammonium sulfate, urea, or other organic materials, have some properties that make them especially desirable for plowing under in these drier regions. In areas where the summer rainfall is good and the soils are light textured (low in clay), top-dressing applications with nitrate carriers, as nitrate of soda, are found to be very effective. However, under such well-aerated moist conditions, the nitrogen in any carrier will soon be nitrified to nitrate.

Oxidation or Reduction in the Soil Affects Nitrification of Ammonia. When an ammonia carrier is plowed under with organic matter, a condition in the soil is developed that tends to keep the ammonia from nitrifying rapidly to nitrates. The organic matter that is covered with moist soil has to decompose in a zone that is short of free oxygen (reducing environment), and the bacteria that do the decomposing grab up all the free oxygen present, including some that is in combination with other elements, as with the iron oxides. As long as this rotting process goes on, the nitrifying bacteria cannot convert ammonia to nitrates. Since plants can use nitrogen in the ammonia form as well as in the nitrate form, none of the availability of the nitrogen is lost, but much is gained, for the ammonia particle (ion) is temporarily held by the clay particle firmly enough to retard it from moving easily in the soil water, either up or down, but yet not held too firmly to be taken up by plant roots. Of course, some ammonia will be converted into nitrates even under such conditions, so it does not mean that plants must feed entirely on the ammonia. When the decomposition of the organic matter is completed, the soil will again become oxidizing, and most of the ammonia will be changed to nitrates.

Clay Particles Will Hold Ammonia Nitrogen. Fig. 2 illustrates what happens when an ammonia or nitrate fertilizer is added to a soil, especially as related to the action of the clay in the soil and effect of organic matter. Ammonia salts will change to nitrate salts in a few days' time under ideal aeration and moisture conditions. Nitrates easily move up or down in all soils, depending on the movement of the soil moisture. The ammonia will not move much, as long as it remains as an ammonia ion.

Study Fig. 2 and these relations are easily understood. Note that in dry weather the movement of nitrates is upward, and they often accumulate at the surface above the root zone of the plants. Some plants are often starved for nitrates because of this movement. Then, too, in dry weather, top-dressings of nitrogenous fertilizers are ineffective, because they will remain on the surface.

PICTORIAL



NEW ENGLAND LANDSCAPES ARE APT TO INCLUDE STONE FENCES AND COWS.

Courtesy, Soil Conservation Service, U. S. D. A.

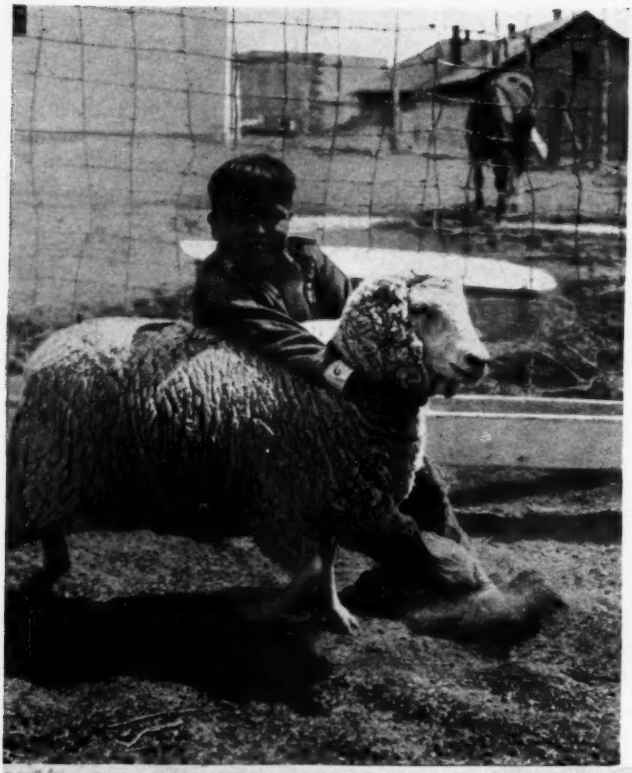
Above: Scenes like this should keep farmers from planting off the contour.

Below: "After lunch" contentment in a newly opened cafeteria.

Courtesy, Soil Conservation Service, U. S. D. A.

Above: Strip-cropping is an erosion control in rich Lancaster County, Pennsylvania.

Below: A good spot to remember on a hot summer's day.



Left: Catching sheep for shearing is sport for this young Indian in Colorado.

Below: A lift to and fro is a foot-saver for many a young farmer who dances at night.

The Editors Talk

—Quality— to the Fore

So much has been written and uttered about the quality factor in successful crop production that it might seem unnecessary for advisory groups and producers to continually keep it in mind. Yet instances recur to show the need for constant attention to the growing and marketing of good quality produce if competition is to be met and best prices obtained.

Such an instance is noted in important discussions during the Citrus Institute, recently held at San Bernardino, California, during which attendants were told that the "Key to better returns is better fruit." The United States in 1939 grew as many oranges as all of the world did 20 years ago, and in those 20 years production of oranges in the United States has almost tripled. Grapefruit production increased from about 6,000,000 boxes to around 40,000,000 boxes. Now comes, in spite of the highly effective promotional work on increasing consumption and educational programs on the health-giving properties of citrus products, the need to increase consumption at prices which will warrant production.

It was brought out during the discussion that much of the poor quality fruit sold in California will now pass the standardization laws, but will not stand shipment to the East. As a result it is sold in California, glutting local markets and reducing prices beyond any chance of returning cost of production to the grower.

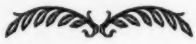
Many growers complain bitterly when standards are raised to points that shippers have found necessary to market a crop advantageously and efficiently. The growers state that such high standards throw out so much of their crop that they have little left to sell. Too few growers realize that what they are selling must compete not only with similar produce offered by others in the same or different localities, but also must compete with the entire list of commodities attracting the consumer's dollar. It is a well-known fact that when a supply of a vegetable or fruit is poor in quality, housewives will pass it up entirely, even though the price is very low, and will purchase a different fruit or vegetable that more nearly meets their standards. The solution does not appear to be the reduction of standards, but rather the improvement of produce to meet present-day market demands.

Essential Plant Foods

There are many factors, of course, which enter into the efficient growing, grading, and marketing of quality produce. However, the initial step goes back to the soil and what it can supply in the way of plant foods necessary for optimum growth. A wealth of evidence has been accumulated on the intelligent use of fertilizer not only to increase yield, but to improve quality and cut unit cost of production. Adequate supplies of certain plant-food elements are known to improve such quality factors as size, shape, flavor, color, juice, mineral, and starch content, texture, and cooking, keeping and shipping qualities of various crops. Carefully conducted tests in California, for instance, have shown that proper fertilization including well-balanced supplies of nitrogen, phosphorus, and

potash will markedly increase the size, weight, and juice content and decrease the thickness of the rind of citrus fruit. In the manufacture of cigars, the very important good-burning quality, which commands premium prices, is largely governed by the amount of available potash which the soil and fertilizer can supply the growing tobacco plants. Another common example is the preference of grazing animals for grasses that have been fertilized.

This evidence of the effect of proper fertilization on the improvement of quality should not be overlooked in consideration of problems of surplusages. It should not be overlooked even by the grower who does not face the keen competition of crowded markets. A reputation for quality produce is an intangible but very valuable asset for any business to acquire. On it largely is based good will, an important market stabilizer.



Total Profit vs. Unit Profit

We have recently observed calculations of returns from practices of fertilization in which total net profit per acre and net profit per dollar invested in the treatment were given. Both of these factors are important in determining the fertilizer treatment most likely to be profitable to the farmer. However, the stress frequently laid upon return per dollar invested would appear at times to be somewhat misleading. A treatment with a low investment is more likely to show a greater return per dollar invested than the treatment with the higher investment; whereas, the total net profit per acre might be greater from the treatment requiring the higher investment.

For example, a treatment costing $1 might increase the value of the crop obtained $7 per acre. This would mean a total net profit of $6 per acre and a return of $6 per $1 invested in the treatment. A second treatment might cost $3 per acre and result in an increase in crop value of $12 per acre. This would leave a total net profit of $9 per acre, but the return per dollar invested would be only $3. In analyzing and discussing the return of such an experiment, to stress the return per dollar invested in the treatment might easily give the impression that the $1 treatment was the more advantageous, since this gave the highest return per dollar invested. Actually the $3 treatment would be the more advantageous for the farmer since it would give him the greatest total profit per acre.

After all, it is the dollars of profit rather than the percentage of profit which pay the bills and put money in the bank. It would seem, therefore, that wherever possible, advisory groups should place the greater emphasis upon the total net return per acre. In such cases, the return per dollar invested should be of secondary importance in the persuasive interpretation of the benefits to be gained from the adoption of more efficient practices of fertilization.

WE ruin the lands that are already cleared and either cut down more wood, if we have it, or emigrate into the western country. . . . A half, a third, or even a fourth of what land we mangle, well wrought and properly dressed, would produce more than the whole under our system of management; yet such is the force of habit, that we cannot depart from it.—George Washington, *In his Letters.*

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

¶ T. E. Odland and T. R. Cox in Rhode Island Experiment Station Miscellaneous Publication No. 5, "Potato Growing in Rhode Island," give a comprehensive discussion on fertilizers for potatoes along with other important subjects including methods and practices that have generally been found successful by growers in the State. The authors point out that the results of long-time experiments show the necessity for an adequate application of high potash fertilizers for potatoes. Grades used at present by most growers, such as the 5-10-10 and 4-8-10 at about one ton per acre, are not far from being as good as could be suggested for ordinary usage. Higher analysis grades, as 8-16-16 or 7-14-21, that are coming into general practice, are said to be entirely suitable, and the amount to be applied may be reduced accordingly. When potatoes are grown in rotation where legumes are included or where farm manure is used on some of the crops, less fertilizer will be needed than when they are grown continuously.

Proper fertilizer placement, rotation and cover crops, varieties, and other information of much value to Rhode Island potato growers are fully explained.

"Fertilizer Formulae," Agr. Exp. Sta., Fayetteville, Ark., 1940, Mimeo.

"Recommendations of the Provincial Fertilizer Board for 1940," Dept. of Agr., Quebec, Can., 1940.

"Results of Bright Tobacco Variety and Fertilizer Experimental Work," Agr. Exp. Sta., Gainesville, Fla., Mimeo., Oct. 14, 1939.

"Fertilizing Onion Sets, Sweet Corn, Cabbage, and Cucumbers in a Four-year Rotation," Agr. Exp. Sta., Urbana, Ill., Bul. 464, Mar. 1940, J. W. Lloyd and J. P. McCollum.

"Fertilizers for Iowa and Their Use," Agr. Ext. Serv., Ames, Iowa, S-117, 1940.

"1940 Fertilizer Recommendations," Agr. Exp. Sta., State College, Miss., Inform. Sh. 196, Jan. 1940, Clarence Dorman.

"Approved Methods of Applying Fertilizers to Crops Grown in the Coastal Plain Section of North Carolina," Agr. Exp. Sta., Raleigh, N. C., Agron. Inform. Cir. 122, Jan. 1940, Emerson R. Collins and Harold D. Morris.

"Sources of Nitrogen for Cotton," Agr. Ext. Serv., Clemson, S. C., No. 3, Jan. 1940.

"Save Plant Food in Manure," Agr. Ext. Serv., Madison, Wis., Cir. 296, Feb. 1940, A. R. Whitson, F. L. Musbach, and A. R. Albert.

"The Behavior of Boron in Soils," U. S. D. A., Washington, D. C., Tech. Bul. 696, Dec. 1939, Frank M. Eaton and L. V. Wilcox.

Soils

¶ "The Soil Auger" is the appropriate title of a new publication of the Massachusetts Extension Service. Intended to serve as a house organ for field workers in the various agricultural agencies dealing with soils problems, it offers a means for the ready and timely dissemination of the results of research and similar information of special interest. According to Extension Soil Conservationist A. B. Beaumont, the plan calls for three to six issues each year, these going to members of State College, County Extension Staff, and to teachers of vocational agriculture in the State.

In introducing Volume I, Number 1 (January 1940), Dr. Beaumont says: "More professional and scientific groups are now soil-minded than ever before. Agronomists and horticulturists have always felt the need of soil knowledge, and to these are now added the foresters, the conservationists, and the economists. All these want soil information and want it quickly. Soil scientists have gone a long way in the solution of

soil problems, yet there are many still unsolved. Sometimes we are exasperated because of the poverty of our knowledge of soils; but that is a healthful sign, for realization of one's ignorance is a starting point of progress. There is much yet to be learned about soils,—in Massachusetts as well as elsewhere."

Ratios and grades of fertilizer for New England, role of calcium in the soil and plant, how to make a soil auger and auger borings, and abstracts of articles in scientific publications, are among the major topics comprising the first issue of "The Soil Auger."

"Distribution and Activity of Azotobacter in the Range and Cultivated Soils of Arizona," Agr. Exp. Sta., Tucson, Ariz., Tech. Bul. 83, Mar. 1, 1940, W. P. Martin.

"Soil Drifting on Cropland in the Plains Area of Montana, with Soil, Insects, and Land Use Supplements," Agr. Ext. Serv., Bozeman, Mont., Bul. 176, June 1939, M. P. Hansmeier.

"Using Conservation Materials," Agr. Ext. Serv., Durham, N. H., 1940, Ford S. Prince.

"Soil Survey, Bonner County, Idaho," U. S. D. A., Washington, D. C., Series 1934, No. 16, Dec. 1939, E. N. Poulson, F. A. Mark, and George Gibbs.

"Soil Survey, Washington County, Indiana," U. S. D. A., Washington, D. C., Series 1932, No. 36, July 1939, John T. Miller, Howard Wm. Higbee, A. T. Wiancko, and M. E. Waggoner.

"Soil Survey, (Reconnaissance) The Red River Valley Area, Minnesota," U. S. D. A., Washington, D. C., Series 1933, No. 25, Apr. 1939, C. C. Nikiforoff, A. H. Hasty, G. A. Swenson, A. L. Gray, E. A. Fieger, Sam Hill, H. C. Newman, C. H. Mattson, J. C. Hide, and Eric Kneen.

"Soil Survey, Sarpy County, Nebraska," U. S. D. A., Washington, D. C., Series 1935, No. 10, Oct. 1939, T. E. Beesley and T. K. Popov.

Crops

¶ Three valuable publications stressing the importance of producing quality cotton were issued recently by agricultural authorities in South Carolina, Georgia, and Missouri. South Carolina Extension Service Circular 179, "Cotton Production in South Carolina," by H. A. Woodle, B. E. G. Prichard, and D. C. Sturgis, is a summarization drawn from 12 years of records of the methods and practices followed by the best cotton farmers of the State who have competed in the annual 5-acre contest. These show the importance of proper fertilization and good cultural practices in growing profitable cotton crops. Georgia Experiment Station Bulletin 204, "Results of Cotton Variety Tests 1936-39," by U. R. Gore, and also Missouri Extension Service Circular 206, "Good Varieties of Cotton for Missouri," by B. M. King, describe the advantages gained by adopting certain varieties that are outstanding in yielding ability and other desirable qualities. Intelligent consideration of the important points given in each of these publications should prove highly profitable to cotton growers in the respective States.

"Fifty-first Annual Report, Fiscal Year Ending June 30, 1939," Agr. Exp. Sta., Fayetteville, Ark., Bul. 386, Feb. 1940, W. R. Horlacher and C. O. Brannen.

"Five New Peach Varieties Especially Adapted to Mild Winters," Agr. Exp. Sta., Berkeley, Calif., Bul. 632, Dec. 1939, J. W. Lesley.

"Crown-Grading Experiments With Asparagus," Agr. Exp. Sta., Berkeley, Calif., Bul. 633, Jan. 1940, H. A. Jones and G. C. Hanna.

"Pasture Is Paramount for Milk and Meat Production in Ontario," Agr. Ext. Serv., Guelph, Ontario, Can., Ext. Cir. 28, May 1939.

"Producing Hay of Higher Feeding Value," Ontario Dept. of Agr., Toronto, Ontario, Can., Bul. 406, Dec. 1939, O. McConkey.

"Annual Report of the Director for the Fiscal Year Ending June 30, 1939," Agr. Exp. Sta., Newark, Del., Bul. 220, Nov. 1939, G. L. Schuster, Dir.

"Better Rural Life in Delaware," Agr. Ext. Serv., Newark, Del., Bul. 30, May 1939, C. A. McCue, Dir.

"Care of Citrus Groves Injured by Cold," Agr. Exp. Sta., Gainesville, Fla., Press Bul. 546, Feb. 1940.

"Sorghum in North Georgia," Agr. Exp. Sta., Experiment, Ga., Cir. 121, Feb. 1940, Thomas S. Boggess and J. E. Bailey.

"Hawaii Agricultural Experiment Station Report, 1939," Agr. Exp. Sta., Honolulu, T. H., Mar. 1940.

"Twenty-second Annual Report of the Department of Agriculture, July 1, 1938 to June 30, 1939," Sta. Dept. of Agr., Urbana, Ill.

"Farm Science Reporter," Agr. Ext. Serv., Ames, Iowa, Vol. 1, No. 1, Jan. 1940.

"Effect of Spacing and Length of Harvesting on Yields of Asparagus," Agr. Ext. Serv., Ames, Iowa, Bul. P6 (New Series), Mar. 1940, E. S. Haber.

"The Vegetable Garden," Agr. Ext. Serv., Ames, Iowa, Ext. Cir. 245 (Revised), Jan. 1940, E. S. Haber and W. H. Collins.

"Thirty-first Biennial Report of the Kansas

State Board of Agriculture to the Legislature of the State for the Years 1937 and 1938," St. Bd. of Agr., Topeka, Kan., Vol. XXXVI.

"Suggestions for Increasing Corn Yields in Central and South Louisiana," Agr. Exp. Sta., University, La., Cir. 23, Mar. 1940, H. B. Brown.

"Corn Production in the Alluvial Section of Louisiana," Agr. Exp. Sta., University, La., Cir. 24, Mar. 1940, C. B. Haddon and D. M. Johns.

"Brussels Sprouts as a Truck Crop," Agr. Ext. Serv., University, La., Ext. Cir. 187, June 1939, G. L. Tiebout.

"Corn Production on the Hill Lands of Louisiana," North La. Exp. Sta., Calhoun, La., Cir. 26, Mar. 1940, Sidney Stewart.

"Cauliflower as a Truck Crop for Late Fall and Early Winter Harvesting," Agr. Ext. Serv., University, La., Ext. Cir. 188, June 1939, G. L. Tiebout.

"The Fifty-second Annual Report of the University of Maryland Agricultural Experiment Station, 1938-39," Agr. Exp. Sta., College Park, Md., Vol. 52, 1939, J. E. Metzger, Dir.

"Hotbeds and Coldframes," Agr. Ext. Serv., East Lansing, Mich., Ext. Bul. 20 (Revised), Mar. 1940, H. L. Seaton, D. E. Wiant, and J. H. Muncie.

"Forty-sixth Annual Report, Agricultural Experiment Station, University of Minnesota, July 1, 1938 to June 30, 1939," Agr. Exp. Sta., Univ. Farm, St. Paul, Minn.

"An Illustrated Guide, Landscaping Mississippi Homes," Agr. Exp. Sta., State College, Miss., Bul. 340, Dec. 1939, R. O. Monosmith and F. S. Batson.

"New Practices to Regulate the Fruit Crop," Agr. Exp. Sta., Columbia, Mo., Bul. 416, Mar. 1940, A. E. Murneek.

"Results of Some Young Apple Tree Pruning Experiments," Agr. Exp. Sta., Columbia, Mo., Res. Bul. 313, Mar. 1940, T. J. Talbert.

"Comparative Accuracy and Efficiency in Determination of Carbohydrates in Plant Material," Agr. Exp. Sta., Columbia, Mo., Res. Bul. 314, Mar. 1940, P. H. Heinze and A. E. Murneek.

"Corn Production in Montana," Agr. Ext. Serv., Bozeman, Mont., Bul. 173, Apr. 1939, Ralph D. Mercer.

"Irrigated Pastures in Montana," Agr. Ext. Serv., Bozeman, Mont., Bul. 174, May 1939, A. H. Post and J. O. Tretsven.

"Alfalfa Seed Production," Agr. Ext. Serv., Bozeman, Mont., Bul. 175, Apr. 1939, Ralph D. Mercer.

"The Blueberry in New York," Agr. Exp. Sta., Geneva, N. Y., Cir. 189, Mar. 1, 1940, G. L. Slate and R. C. Collison.

"The Home Garden and the 1940 Agricultural Conservation Program," Agr. Ext. Serv., Raleigh, N. C., Ext. Folder 45, Feb. 1940, H. R. Niswonger and Mary E. Thomas.

"The Performance of Corn Hybrids in North Carolina," Agr. Exp. Sta., Raleigh, N. C., Agron. Inf. Cir. 124, Paul H. Harvey and Gordon K. Middleton.

"The Ohio Cooperative Corn Performance Tests," Agr. Exp. Sta., Wooster, Ohio, Sp. Cir. 59, Jan. 1940, G. H. Stringfield, R. D. Lewis, and H. L. Pfaff.

"Potato Growing in Ohio," Agr. Ext. Serv., Columbus, Ohio, Bul. 86, June 1939, E. B. Tussing.

"How I Grew My Potatoes," Agr. Ext. Serv., Columbus, Ohio., 4-H Cir. 121, Mar. 1939, E. B. Tussing.

"A Progress Report of Corn Investigations in Oklahoma, 1939," Agr. Exp. Sta., Stillwater, Okla., Mimeo. Cir. 52, Mar. 1940, C. B. Cross.

"Annual Report for 1938 Agricultural Extension Service, Rhode Island State College," Agr. Ext. Serv., Kingston, R. I., Bul. 77, Feb. 1939, P. S. Burgess.

"Potato Growing in Rhode Island," Agr. Exp. Sta., Kingston, R. I., Misc. Pub. 5, Jan. 15, 1940, T. E. Odland and T. R. Cox.

"1938-1939 Annual Report of the Department of Agriculture to the Governor of the State of South Dakota for the Fiscal Year Ending June 30, 1939," St. Dept. of Agr., Pierre, S. Dak.

"The Chemical Composition of Forage Grasses of the East Texas Timber Country," Agr. Exp. Sta., College Station, Brazos County, Tex., Bul. 582, Mar. 1940, G. S. Fraps and J. F. Fudge.

"Sweet Potato Growing," Agr. Exp. Sta., College Station, Tex., Prog. Rpt. 662, Feb. 19, 1940, R. E. Wright.

"Forty-ninth Annual Report for the Fiscal Year Ended June 30, 1939," Agr. Exp. Sta., Pullman, Wash., Bul. 384, Dec. 1939.

"Rebuilding Wheat Lands with Grasses and Legumes," Agr. Ext. Serv., Pullman, Wash., Ext. Cir. 28, Apr. 1939, Leonard Hegnauer.

"What's New in Farm Science," Agr. Exp. Sta., Madison, Wis., Bul. 449, Mar. 1940.

"Plan Wisconsin Pastures," Agr. Ext. Serv., Madison, Wis., Cir. 298, Mar. 1940, F. V. Burcalow and G. Bohstedt.

"Safeguard the New Seedings," Agr. Ext. Serv., Madison, Wis., Cir. 300, Apr. 1940, H. L. Ahlgren and L. F. Graber.

"Western Grass," U. S. D. A., AAA, Washington, D. C., G-98, 1940.

"Directory of Organization and Field Activities of the Department of Agriculture: 1939," U. S. D. A., Washington, D. C., Misc. Pub. 376, Feb. 1940.

Economics

¶ According to the recent statistical release of the State Inspection and Regulatory Service at College Park, Maryland, the Maryland farmers used some 164,585 tons of commercial fertilizer in 1939, of which 65,594 tons were Maryland standard analyses fertilizers as recommended for 1939, and 130,425 tons were of the 15 leading grades.

The four leading grades in order of their importance are 2-9-5, 2-12-6, 6-6-5, and 2-8-10. It was estimated that 4,508 tons of nitrogen, 14,143 tons of phosphoric acid, and 10,107 tons of potash were contained in mixed fertilizers sold in Maryland in 1939. The report contains other interesting facts with respect to the fertilizer industry in Maryland.

¶ The Control Series Bulletin No. 100 of the Agricultural Experiment Station at Amherst, Massachusetts, contains much worth while information with respect to the fertilizer industry in that State. For instance, from July 1, 1938, to July 1, 1939, 41,616 tons of mixed fertilizers, 20,800 tons of materials, and 1,558 tons of pulverized natural manure, making a total of 63,974 tons of fertilizers, were sold in Massachusetts. It was reported that there were 12,890 tons of plant food contained in this tonnage, 27% was nitrogen, 43% was phosphoric acid, and 30% was potash. Mixed fertilizers furnished 67.6% of the plant food used and unmixed materials 31.6%, and manures .8%. The four leading grades in order of their importance were 5-8-7, 4-8-4, 4-8-7, and 6-3-6.

¶ According to the "1939 Fertilizer Bulletin," statistical release of the Soils Department of Michigan State College, total fertilizer sales in 1939 amounted to 144,811 tons, of which 98,566 tons were sold in the spring and 46,245 tons in the fall. Of the total, 123,914 tons were in the form of mixed goods, and 14,804 tons were superphosphate. Nearly 89% of the tonnage was composed of grades in ratios recommended by the Soils Department, and 93% of the mixed goods contained 20% or more plant food, compared to 73% in 1934, 78% in 1935, and 89% in 1938. The 10 leading grades made up about 79% of the total. The 10 best sellers in order of their importance were 2-12-6, 0-20-0, 2-16-8, 2-12-2, 2-8-16, 4-16-4, 0-14-6, 3-12-12, 5-10-5, and 0-8-24. The 2-12-2 declined in importance, and 2-16-8, 0-14-6, and 3-12-12 increased in importance.

"Annual Summary of Fruit and Vegetable Unloads in Honolulu, 1939," Agr. Ext. Serv., Honolulu, T. H., Agr. Ext. Cir. 65, Mar. 1940, Kenneth I. Hanson and Kenichi Murata.

"A Farm Management and Cost Study on 500 Family-Sized Farms in the Louisiana Sugar Cane Area, 1938," Agr. Exp. Sta., University, La., La. Bul. 314, Feb. 1940, W. W. McPherson and J. N. Efferson.

"Financial Results of the Operation of Large Sugar Cane Farms in Louisiana, 1937, and 1938," Agr. Exp. Sta., University, La., La. Bul. 315, Feb. 1940, Roy A. Ballinger.

"Financial Results of the Operation of Sugar Mills in Louisiana, 1937 and 1938," Agr. Exp. Sta., University, La., La. Bul. 316, Feb. 1940, Roy A. Ballinger.

"Some Results of a Farm Management Survey in Rapides, Union, Claiborne, and DeSoto Parishes, 1938," Agr. Exp. Sta., University, La., La. Bul. 317, Mar. 1940, J. N. Efferson.

"Crop Report for Michigan, Annual Crop Summary, 1939, and Crop Statistics 1929-1939," St. Dept. of Agr., Lansing, Mich., Jan. 1940.

"Amounts and Cost of Credit Extended by Cooperative Exchanges," Agr. Exp. Sta., Columbia, Mo., Bul. 415, Feb. 1940, Ralph E. Mercer and Herman M. Haag.

"Missouri Farm Prices Since 1910," Agr. Exp. Sta., Columbia, Mo., Res. Bul. 312, Mar., 1940, Herman M. Haag.

"Tenth Annual Report of the New Mexico Feed and Fertilizer Control Office, Year Ending Dec. 31st, 1939, Commercial Fertilizers," Feed and Fer. Cont. Office, State College, New Mexico, Feb. 1, 1940, R. W. Ludwick and Lewis T. Elliott.

"An Economic Study of Land Utilization in Yates County, New York," Cornell Univ. Agr. Exp. Sta., Ithaca, N. Y., Bul. 727, Jan. 1940, M. D. Woodin.

"Costs in Dairy Farming," Cornell Univ. Agr. Ext. Serv., Ithaca, N. Y., Bul. 427, Feb. 1940, L. C. Cunningham.

"Analyses of Commercial Fertilizers, Spring and Fall, 1939," St. Dept. of Agr., Raleigh, N. C., Vol. 111, No. 1, Mar. 1940.

"A Study of the Farm Business of 74 Farms in Northern Orleans County, Vermont," Agr. Ext. Serv., Burlington, Vt., Brieflet No. 545, Jan. 1940, Hermon I. Miller and Roger D. Whitcomb.

"Leasing Washington Farms," Agr. Exp. Sta., Pullman, Wash., Bul. 385, Jan. 1940, Alden E. Orr.

"Hay Quality, Relation to Production and Feed Value," U. S. D. A., Washington, D. C., Misc. Pub. 363, Nov. 1939, E. O. Pollock and W. H. Hosterman.

"Texas and Oklahoma Handbook for Range Conservation," U. S. D. A., AAA, Washington, D. C., SRB-451, Nov. 7, 1939.

"Feeding Farm Folks Through the Farm's Own Program," U. S. D. A., AAA, Washington, D. C., SRAC-No. 7, Dec. 1939.

Foreign and International Agriculture

To supply information on agricultural research and practice in other countries, brief abstracts of articles in foreign publications are given here. Due to space limitations, only articles of general fundamental interest are included, although the publications may contain other articles and reviews.

Die Ernährung der Pflanze, Vol. 36, No. 2, February 1940

WATER CULTURE EXPERIMENTS ON THE LIME-POTASH QUESTION. *By F. Alten and H. Orth, Berlin, Germany.*

A mutual relationship between calcium and potassium affecting their absorption by plants was observed by Wolff in 1871. Ehrenberg studied this further and in 1920 expounded his lime-potash law which stated that an antagonism existed between the two nutrients, high calcium reducing potassium absorption by plants. This law was supplemented by observations of Lundegardh in 1932, when he showed that increasing amounts of potassium depressed the absorption of calcium.

The authors report on further experiments on the lime-potash relationship, conducted by growing oats in water culture with increasing concentrations of one cation accompanied by decreasing concentrations of the other, sodium being constant and at two levels. Length of leaves, dry weight, and ash composition were determined.

As the potassium, calcium, or magnesium in the solution was increased, the content of the respective element in the ash was increased. At the same time, one or more of the other elements was decreased. The total content of cations was fairly constant regardless of treatment. As the potassium content of the solution, and consequently of the ash, was decreased, the sodium content increased. Sodium did not increase in the plant when calcium decreased. These high sodium, low potassium plants did not make good growth. At the lower level, magnesium decreased rather regularly as the potassium increased and calcium decreased. At the higher magnesium level in the nutrient solution, the magnesium content of the ash assumed a U-shaped curve, being high with either potassium or calcium high, and low when the two elements were equal. The silica in the raw ash tended to follow the same course as the magnesium.

Lime-Potash Law

Ehrenberg's lime-potash law appears to be rather well substantiated by the data. When calcium is very low, additions of the element increase potassium absorption, but with added increments of calcium, the potassium absorption is depressed. The authors state that they could not find a decrease in calcium absorption with increasing potassium in the solution, as was found by Lundegardh. They state, however, their data indicate that with constant calcium supply, an increasing potassium supply would depress the amount of calcium absorbed.

Best growth and yields of the plants occurred when the nutrient solution contained the cations in the following ratio on the basis of milliequivalents: 6.5 K, 3 Ca, 2 Na, 0.5 Mg. Good growth will occur over quite a range of calcium : potassium ratios, centering around a 1:1 ratio. At a higher magnesium supply, the plants are much more sensitive to differences in calcium : potassium ratios. Potassium starvation reduced growth much more than did calcium starvation. With higher magnesium supply, a reduction in calcium supply was much more deleterious than with lower magnesium supply.

THE INFLUENCE OF GROWING CONDITIONS AND CULTURAL PRACTICES ON THE TUBER AND STARCH YIELD AND ON THE QUALITY OF POTATOES. *By M. Platzmann, Hohnstädt, Germany.*

The author refers to previous work on the yield and quality of potatoes, in which only starch and not protein content of the tubers was reported. It is felt that this is a serious oversight, since the amount and form of the protein in the potatoes is considered to be of great significance in determining taste, feeding value, keeping, cooking, and processing qualities. Published work on potato experiments causes the author to suspect that frequently the phosphoric acid and potash applied are not sufficient to balance correctly the amount of nitrogen applied in fertilizer, manure, and green manure. Such unbalanced fertilization results in abnormally large top or vine growth and delayed maturity. The tubers must be harvested before they are ripe, and are then poor in taste and keeping quality. The author believes this to be due to large amounts of amides being present in the low starch tubers, the nitrogen not yet having been transformed to the more valuable protein forms. Such tubers are much less desirable for fermentation purposes owing to their tendency to produce foam during fermentation. Their lower starch content, of course, also results in less alcohol being produced.

The author gives his own experiences with growing potatoes on loamy sand soils. A lupine green manure crop which had been fertilized with 600 pounds of 0-9-15 per acre was turned under for the potatoes. Owing to the healthy appearance of the lupine, no further fertilization for the potatoes was considered necessary. However, the potato tops remained green up to frost time, and the crop had to be harvested before they died down. The yield was good, about 400 bushels per acre, but the starch content was only 14-15%, and rotting set in shortly after harvesting. The tubers fermented with much frothing, and the alcohol yield was very unsatisfactory.

Phosphate and potash fertilization has been increased on these fields, until now 1,000 pounds of 0-10-18 per acre are applied to the potatoes or the preceding lupine green manure. The author is not sure he has yet reached the optimum amounts for the mineral nutrients. No further nitrogen is applied, if a good green manure is turned under. Without green manure, 75-80 pounds of nitrogen and about 15 tons of manure are applied. Yields are now running up to 450 bushels per acre, with starch content 18-20%, thus giving up to 2.7 tons of starch per acre.

INFLUENCE OF POTASSIUM AND NITROGEN NUTRITION ON CARBOHYDRATE METABOLISM IN KOK-SAGYZ. *By A. Kalinkewitsch.*

This abstract summarizes sand-culture pot experiments with the rubber-producing plant Kok-Sagyz (Taraxacum Kok-Sagyz Rodin). The production and storage of rubber occur in the root, and are closely related to the carbohydrate content of the root. The author conducted experiments to determine the influence of nitrogen and potassium supplied in different amounts and at different times on carbohydrate content of the plant. Increased nitrogen nutrition increased the reducing sugars in all parts of the plant, while potassium increased the saccharose. High nitrogen application at time of leaf formation increased sugar formation. Applying nitrogen late in the season caused new leaf formation and reduction in carbohydrate transfer to the roots, and consequently reduced rubber formation. Reducing the nitrogen or increasing the potassium during the late growth had an opposite and favorable effect on rubber production. High potassium nutrition increased sugar production by the leaves and caused more sugar to be transported to the roots, thus increasing rubber production.

THE CHOCOLATE SPOT DISEASE OF HORSE BEANS. *By A. R. Wilson, England.*

The chocolate spot disease attacks horse beans in the many different countries where the crop is grown. At times the disease assumes epidemic proportions. There has been some difference of opinion as to what organism causes the disease, but the author believes that several species and forms of the genus Botrytis are the causal organisms. There appears to be two forms of the disease, an aggressive and a non-aggressive form.

The disease is much worse when the beans are growing on soils low in phosphorus and potassium. If sufficient amounts of these nutrients are present, and especially if large amounts of potash fertilizer are applied, damage by the disease is greatly reduced, due apparently to the aggressive form of the causal organism not being able to attack the plants successfully under these conditions.

THE ORIGIN AND DISTRIBUTION OF SEVERAL LEGUMINOUS PLANTS. *By A. Fischer, Müncheberg, Germany.*

In a series of maps, accompanied by a short discussion, place of the origin and world distribution of the following leguminous plants are given: Canavalia species (jackbeans or Madagascar beans); Schizolobium utile (split pod tree); Dolichos (hyacinth bean); Cajanus indicus (Pigeon pea); Lathyrus species (lathyrus, sweet pea, chickling vetch, etc.); Vicia species (vetches); Vigna Savi (cowpeas).

Annales Agronomiques, Vol. 10, No. 1, January-March 1940

ON THE MAGNESIUM IN CHLOROPHYLL. *By M. Javillier and S. Goudchaux, France.*

A method is described for separating the magnesium contained in chlorophyll from the total magnesium in the plant. This is based on extracting the chlorophyll and determining the magnesium contained therein by a micromethod adapted to small plant samples by the authors. The chlorophyll content can be calculated from the magnesium found to be present.

The magnesium in the chlorophyll, together with the calculated chlorophyll content for a number of plants, in some cases at different times of the year, are given. For a few crops the total magnesium also was determined, and the ratio of chlorophyll to total magnesium calculated. The magnesium in the chlorophyll ranges from 1 to 3 ppm. dry matter, with the chlorophyll running from 36-110 ppm. The chlorophyll magnesium ran from 0.9-26% of the total magnesium in the plant. Thus the absolute and proportionate amounts of two types of magnesium varied widely with different plants.

Cotton Is Improved

(*From page* 19)

year with an unfavorable season a larger application of a higher analysis fertilizer may give yields of less than a bale. This is one reason why it sometimes takes several years to get good practices established in an area. Supervisors can help farmers arrive at correct conclusions.

I do not mean to infer that varieties of cotton do not vary in their ability to withstand adverse conditions. They do. The staple of some varieties shortens more during a period of drouth than others. Some varieties will produce a larger weed than others during a rainy season, etc. In such cases farmers need assistance in drawing correct conclusions.

There is a marked difference in lint percentage of the best varieties. Many

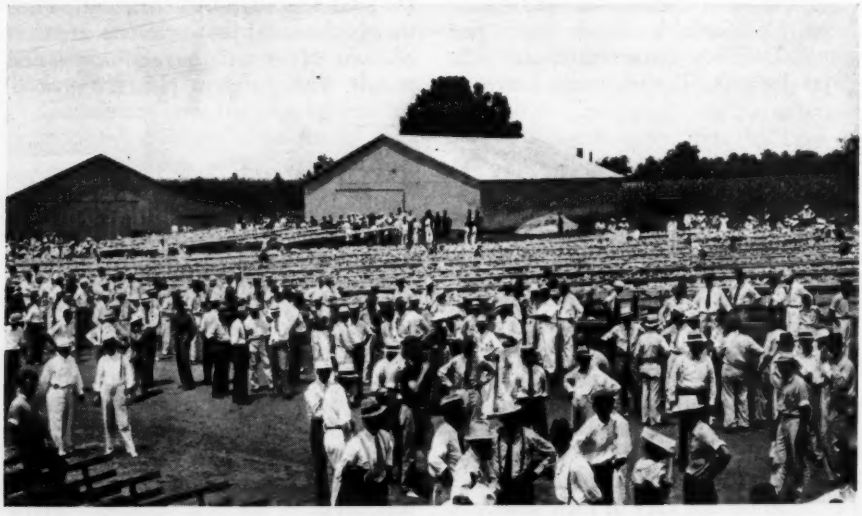
farmers prefer varieties with high "gin turn out." This is a problem that cannot always be ignored. Certain strains of some varieties have been hard to pick. Although the breeder soon developed other strains of the same variety that were easy to pick, many farmers became prejudiced against it and changed to another variety.

The one-variety plan has made it possible to change cotton production in Georgia from a very one-sided, poorly balanced program of production, to a program of production that gives our local mills more nearly the kind and amount of the various staple lengths they most desire. The change has not only been profitable for the cotton manufacturers, but has also given our cotton farmers an added income from premiums and larger yields which has averaged from $5 to $10 per acre.

It is recognized that conditions are not the same in all parts of the cotton belt. In sections of the cotton belt, far removed from consuming centers, the methods of cotton improvement used, as in all cases, should be ones that will best serve the needs of the areas concerned. Apparently certain areas are not as well suited to the production of 1-inch and longer cotton as other areas. The wisdom of growing 1-inch and longer cotton in some areas may be subject to question.

One of the things which has made it difficult to keep the cotton-improvement program on as high level of efficiency as desired, has been lack of adequate personal supervision of the one-variety communities. Supervision which normally could be expected from county agents in many cases has been woefully lacking. County agents have been so completely tied up with AAA programs that some of them find little or no time to give to the supervision and direction of the cotton-improvement program. This condition will have to be corrected, or at least improved, before best results can be expected.

As to the solution of some of the cotton-improvement problems, in my opinion we should emphasize in every way possible better farming practices. Farmers should be interested in all phases of cotton production, such as improvement in cropping systems, better fertilization, seed treatment, boll-weevil control, etc., so as to increase yields per acre and lower production cost. A cotton-improvement program which not only includes purchase and care of the seed, but one which will include



The annual barbecue in the Orchard Hill One-variety community.

all of the foregoing things, will come nearer getting and holding interest of cotton farmers than the value of quality cotton and good seed alone. Very satisfactory progress has been made in recent years along these lines, and with the increased interest in better methods of production it should be easier to expand and enlarge upon the cotton-improvement project. Sometimes better results can be obtained by stressing the good yielding qualities of a variety, than by calling attention to premiums which might be obtained for longer staple length.

Specific information on methods of production for specific varieties will enable farmers to make maximum yields. For example, with Coker's 4-in-1 cotton, farmers in South Carolina have made very attractive yields by planting in 3-foot rows and spacing thickly in the drill. Coker's 4-in-1 is a dwarf cotton and has very thin foliage.

Further Research Needed

Various plans for renewal of seed have been suggested, but none of them will work equally well in all communities. This continues to be a major problem, and should receive more thorough study. Increased personnel, Federal, State, and County, will aid greatly in maintaining interest and preventing mistakes.

A thorough study of the spinning qualities of the principal varieties of cotton now in use should supply information as to the varieties that should be grown most extensively. At the present time very little definite information is available on the spinning value of the varieties now in use.

We are very much in need of information on consumption of cotton by staple lengths for both domestic and foreign demand. It is our belief that considerable change has been made by manufacturers during the last few years as to the kind of cotton they most desire. Up-to-date information of this kind should be very helpful in promoting the type of production program that would be of greatest value to all concerned.

A satisfactory cotton-marketing program should be made a part of any cotton-improvement program. Some effort along this line has been made. One-variety tags have been placed on bales, cotton bagging has been used, mills have been requested to make comparison of the spinning value of the one-variety cotton with other cotton, etc. Efforts along these and other marketing lines should be extended, and the requirements for test lots of cotton made more exacting.

A program for better ginned cotton should be a part of any well-rounded cotton-improvement program. Cotton farmers lose a large sum annually because of rough ginned cotton. Premiums for 1-inch and longer cotton over $\frac{7}{8}$-inch may be much smaller in future years than for past years. A good ginning job will aid farmers in obtaining the highest market price.

Improvement of some of the new services, such as the Smith-Doxey Service, and expansion of these services will supply information to farmers and leaders of cotton-improvement projects. This should make it possible to have a definite yardstick for measuring the quality of the cotton grown by each individual farmer. In this way it will be possible for the leaders to expend their energies where the best results may be expected.

In conclusion, may I say that the cotton-improvement program has obtained results during the last 7 years which are very gratifying. This progress has been made with only a small additional expenditure in funds or increase in personnel. The cotton-improvement work in Georgia is a cooperative project, conducted jointly by the Agricultural Extension Service, the Georgia Experiment Station, and the U. S. Bureau of Plant Industry. Recently R. R. Childs, former Professor of Cotton Industry at the Georgia State College of Agriculture, has been employed jointly by the Agricultural Extension Service and the U. S. Bureau of Plant Industry to devote his entire time to one-variety cotton work in Georgia. This will give us a good set-up, from which even greater results are expected in the future.

Legumes Are Making A Grassland Possible

(*From page* 11)

tion against losses due to soil erosion. It provides succulence during the hot, dry part of the summer when grasses are dormant. In areas where white grubs are a problem, a good growth of alfalfa or sweet clover will give protection from these pests for a period of years. With regulated grazing, good stands of legumes can be maintained for several years. Even after the legumes have disappeared, the residual benefits to the grass will be evidence for several years.

The old axiom, "Take care of the legumes, and the grasses will take care of themselves," is being put into practice by restoring lime, phosphate, and potash to depleted soils, so that the legumes may be established in association with grasses.

Such expanses of legume grasslands insure feed reserves for a more profitable agriculture.

Potash Deficiency In New England

(*From page* 9)

liberal potash application. Grass hay and some of our vegetable crops are less demanding on this plant-food material.

Although kainit was the most efficient source for tomatoes and mangels in this experiment, it is not at present an important general source. Potash materials of higher grade have largely replaced low analysis materials such as kainit, on account of the higher cost per unit of low grade sources and their inadaptability for use in high analysis fertilizer. For the same reason sulfate of potash-magnesia, such as used in this experiment, is not a major source of potash. This leaves the chief comparison as that between muriate and sulfate of potash. These experiments do not show any great advantage for either one as against the other for crops in general. The sulfate was a little to be preferred on the basis of yield on some crops, while the muriate source had a little advantage on others. The source that will furnish the largest number

Mangels on potash experiment, 1939. Left, low potash, 8.53 tons per acre; center, medium potash, 13.80 tons per acre; right, high potash, 20.36 tons per acre.

of units of potash per unit of cost is the one that will generally bring the greatest return per dollar invested. There are some exceptions to this rule. Tobacco growers in certain regions, for example, have found that the sulfate form will produce the best quality in their product.

Other tests made on many soil types and in various sections of the State have all shown that potash is generally deficient and must be supplied in some form in order to grow satisfactory crops. This applies to vegetable crops as well as to general farm crops, such as corn and potatoes.

Borax As A Control

(*From page* 16)

in yield were not large enough to be significant. Very good control of heart rot was obtained by the use of borax on these areas, and it would seem that greater increases in yield should have resulted. Perhaps better results would have been obtained from a still smaller application. This is doubtful, however, since in only one case was the stand injured by the 10-pound rate. In a large number of fertilizer experiments with sugar beets, conducted at the Michigan Station during the past 6 years, it has been impossible to keep the errors of the experiments below a figure approximately equal to 10% of the total yields. Much of the error probably is due to soil differences, although great care has been exercised in selecting fields with uniform soil. Perhaps it is too much to suppose that, except in extreme cases, borax should increase the yields as much as 10%.

The fact that such increases may be obtained in extreme cases is illustrated by the results obtained from a side-dressing of borax made on June 29 on Thomas sandy loam soil. An application of 9 pounds of borax per acre on this area where heart rot was particularly bad resulted in a very significant increase in yield. As shown by the data presented in Table 7, the yield of all beets was increased from 43.8 pounds to 62.8 pounds per plat, while the yield of normal beets was increased from 10.0

to 23.8 pounds per plat. If the borax had been applied at planting time, the increases in yield would have been even greater.

This seems certain, because on soil taken from this same area and placed in pots in the greenhouse, an application of 10 pounds of borax completely

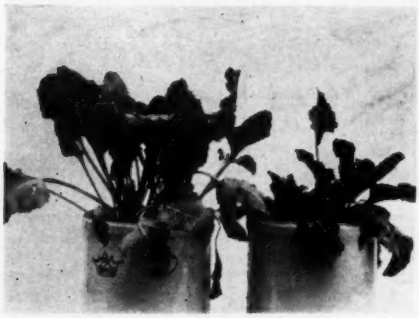


Fig. 8—Sugar beets on Thomas sandy loam soil. Left: 10 lb. of borax per acre mixed with the soil. No symptoms of heart rot developed. Right: No borax. All plants showed heart rot symptoms.

prevented heart rot. This experiment has already been described. The application made in the field on June 29 was too late to prevent the appearance of heart rot on many of the plants, and it is believed that the help from the borax came mostly through the recovery of the already affected plants. Past work in the greenhouse has shown that beets affected with heart rot will completely recover if borax is applied before the breakdown of tissue is too far advanced.

Effect of Borax on Heart Rot Occurrence—As indicated by counts made of plants showing heart rot symptoms, borax has been very effective in controlling this disorder. As shown by the data presented in Tables 8, 9, and 10, all applications of borax, 10 to 80 pounds per acre, reduced the number of beets showing heart rot symptoms significantly below the number reported for the control. In only one case, that of a broadcast application on the Napanee soil, was there a significant difference between the counts obtained on the plats treated at the rate of 10 pounds per acre and on one receiving a heavier application. That would indicate that 20 pounds was enough to apply in any case, whether the application was to be made broadcast or in the row. As already mentioned, there is a possibility that fairly good control could be obtained with less than 10 pounds per acre applied in the row.

The Effect of Heart Rot on Sucrose Content and Purity—The profit from an application of any fertilizer to sugar beets may come through larger yields or through an increase in sugar percentage. As already reported, large increases in yield from a few pounds of borax can only be expected in extreme cases. It is believed, however, that the sugar content will be appreciably increased wherever borax is effective in preventing the occurrence of heart rot.

This belief is the result of the data reported in Table 11. For 3 years attempts were made at the Michigan Station to find out whether or not an application of borax would affect the sugar content and purity of sugar beets. Samples were gathered at random from treated and untreated plats, without regard to heart rot symptoms. This was perhaps an inaccurate way of taking samples, as it seems only logical that borax could only affect the sugar content of those beets which, without the treatment, would have developed heart rot. It is impossible to predict with certainty whether or not any particular beet will develop heart rot, so another method of approach was adopted in 1939.

The beets from an area where damage from heart rot was severe were divided into three lots, those which did not have symptoms of heart rot, those which had symptoms only on the leaves, and those which had root symptoms as well as leaf symptoms. Six samples of each of these lots were taken from two different soils. As shown by the data (Table 11), the beets with heart rot contained significantly less sugar than did the normal beets. Further, the beets with symptoms on both leaves and roots contained less sugar than did those with only leaf symptoms. This difference was significant in one soil.

These results would indicate that the occurrence of symptoms on both leaves and roots is an indication of an advanced stage in the tissue breakdown.

A significant drop in the coefficient of purity was also found in beets grown on the Thomas soil. Normal beets showed a purity of 85.4% as compared to a purity of 76.4% in beets with both types of symptoms.

It has already been shown by the data reported in Table 1 that borax applied to pot cultures completely controlled heart rot and increased the sucrose content of the beets from 15.4% to 17.0%.

It is believed that sufficient data have been reported to prove that an application of a few pounds of borax per acre may be expected to prevent the occurrence of heart rot in sugar beets either in the field or in the greenhouse. From greenhouse experiments in which it is believed that at least certain errors may be better controlled than in the field, and from field trials on areas where heart rot was severe, the conclusion may be drawn that in cases where heart rot is prevented by borax applications, yields will be increased as a result of treatment.

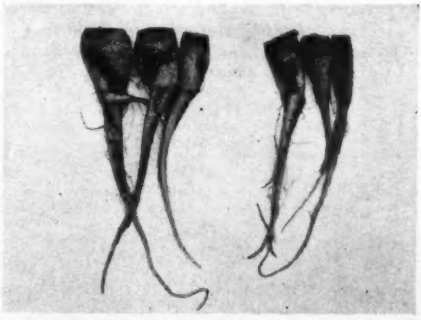


Fig. 9—Roots produced in the pot cultures shown in Fig. 8. Left: 10 lb. of borax. Right: No borax.

Even in areas where heart rot is less severe, it seems logical that borax should increase sugar beet yields. In the experimental work presented in this paper, the increases were statistically insignificant, but it is believed that actual increases in yield would have been shown, if it had been possible to control the experimental errors more closely. It is plainly evident that a beet which suffers tissue breakdown and a drop in sugar percentage, as the result of a lack of boron, cannot possibly produce the sugar which it would have produced had it remained healthy.

At the sugar factories it is necessary to store sugar beets in large piles for varying lengths of time. Smith (5) has stated that only sound, healthy beets should be placed in these piles. In many cases the tissue breakdown caused by boron deficiency is followed by rot resulting from the entrance of some organism. Such roots would be unfit for storage in large piles.

Summary and Conclusions

Sugar beets, grown in Thomas sandy loam pot cultures, were supplied with a complete nutrient solution as a control treatment. Copper, manganese, magnesium, and boron were separately omitted from and doubled in quantity in the control treatment solution to ascertain the effect of each of these elements on the development of the sugar beet plant.

During the years 1937, 1938, and 1939 field experiments were conducted in 10 fields located on 6 different soil types. Borax, included in 2-12-6 fertilizer, was applied broadcast and in the row at rates ranging from 10 to 80 pounds per acre. In one experiment borax was applied as a side-dressing. The effect of heart rot on sucrose and purity percentages was determined by collecting samples from fields not included in the experiments.

The results from these experiments may be summarized as follows:

1. Borax, applied to Thomas sandy loam pot cultures at the rate of 10 pounds per acre, prevented heart rot, practically doubled yields, and significantly increased the sucrose content of sugar beets.
2. Copper, manganese, and magnesium did not prevent heart rot nor affect the yield and sucrose content of sugar beets.
3. Borax applied broadcast in the field at rates as high as 80 pounds per

acre did not injure stands nor reduce yields.

4. Borax applied with the seed at the rate of 10 pounds per acre injured the stand on one field in 1939 but did not affect the stand on seven other fields in 1938 and 1939.

5. As much as 40 pounds of borax per acre applied in the row did not reduce the stand of beets on some soils.

6. Borax applied in a band to the side but not in contact with the seed was much less harmful to stand than was borax applied with the seed.

7. Borax applied broadcast or with the seed did not significantly increase sugar beet yields. It is believed that significance would have resulted in some cases had it been possible to better control experimental errors.

8. Borax applied as a side-dressing on an area where heart rot was very severe significantly increased total sugar beet yields and more than doubled the yield of normal beets.

9. Borax applied in the row at the rate of 10 pounds per acre almost completely prevented heart rot occurrence. Broadcast applications at the same rate were somewhat less effective, and on one field the 20-pound application produced significantly better results than did the 10-pound application.

10. Sugar beets having heart rot contained less sucrose than did normal beets.

11. On one field, the sugar beets having heart rot had a lower percentage purity than did normal beets.

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Fig. 10—Borax applied in contact with sugar beet seed may be toxic when the rate of application is too great. The two rows in the center received 80 lb. of borax per acre with the seed. The two rows on the left received 20 lb. and the two on the right 10 lb. per acre. The two lighter applications actually resulted in better stands than were obtained where borax was not applied. On another soil during the same year, an injury to stand resulted from the 10 lb. application.

TABLE 1.—THE EFFECT OF BORAX ON HEART ROT OCCURRENCE AND THE YIELD AND SUCROSE CONTENT OF SUGAR BEETS IN WAUSEON SANDY LOAM POT CULTURES

Treatment	Plants showing heart rot	Green weight per pot [1]		Sucrose content of roots [2]
		Roots	Tops	
	per cent	*grams*	*grams*	*per cent*
Complete nutrients (control)	0	90.4	131.4	17.0
Complete nutrients, less copper	0	101.9	145.0	16.0
Complete nutrients, double copper	0	97.7	139.8	16.4
Complete nutrients, less manganese	0	99.4	120.0	16.5
Complete nutrients, double manganese	0	102.3	135.6	16.3
Complete nutrients, less boron	100	46.7*	109.0*	15.4*
Complete nutrients, double boron	0	81.7	136.6	17.3
Complete nutrients, less magnesium	0	91.2	133.5	17.8
Difference required for significance		17.7	18.3	1.06
F		8.97	3.31	5.64
F (5% point)		2.29	2.29	3.80
F (1% point)		3.22	3.22	7.02

* Significantly less than control.
[1] Yields are averages of six replicates.
[2] For sucrose determinations it was necessary to combine the roots from three pots. The percentages then represent duplicate samples. One missing figure was supplied.

TABLE 2.—THE EFFECT OF BORAX APPLIED BROADCAST ON THE YIELDS OF SUGAR BEETS IN 1938

Treatment in addition to 2–12–6 fertilizer	Yields—Tons per acre Averages of four replicates	
	Miami silt loam	Napanee silt loam
No borax (control)	6.7	9.8
10 pounds borax before planting	6.9	10.5
20 pounds borax before planting	6.5	10.9
40 pounds borax before planting	7.1	10.9
80 pounds borax before planting	7.7	10.8
Difference required for significance	1.23	1.29
F	1.27	1.24
F (5% point)	3.26	3.26
F (1% point)	5.41	5.41

TABLE 3.—THE EFFECT OF BORAX APPLIED IN THE ROW ON THE STAND OF SUGAR BEETS IN 1938

Treatment in addition to 2–12–6 fertilizer	Plants per 200 feet of row Averages of five replicates		
	Brookston silt loam	Napanee silt loam	Miami silt loam
No borax (control)	161.4	172.8	179.0
10 pounds borax with seed	182.0	172.8	173.6
20 pounds borax with seed	192.8	171.4	165.6
40 pounds borax with seed	171.0	151.8*	102.8*
80 pounds borax with seed	131.0*	112.0*	40.4*
Difference required for significance	19.6	14.5	32.4
F	13.00	29.60	26.74
F (5% point)	3.01	3.01	3.01
F (1% point)	4.77	4.77	4.77

* Significantly less than control.

TABLE 4.—THE EFFECT OF BORAX APPLIED IN THE ROW ON THE STAND OF SUGAR BEETS IN 1939

Treatment in addition to fertilizer[1]	Plants per 200 feet of row				
	Miami[1] silt loam	Napanee[2] silt loam	Onaway[3] loam	Posen[3] loam	Thomas[1] sandy loam
No borax (control)	209.0	164.8	250.4	216.4	160.4
10 pounds borax with seed	176.8*	191.2	216.0	201.0	162.2
20 pounds borax with seed	169.3*	186.9	204.4*	198.4	135.4
40 pounds borax with seed	57.3*	160.8	.....	.....	110.0*
80 pounds borax with seed	69.3*	64.8*	.....	.....	52.6*
80 pounds borax in side band	159.5*	163.4	.....	.....	155.4
Difference required for significance	29.5	20.1	32.88	19.68	25.9
F	37.7	45.7	6.34	2.94	22.84
F (5% point)	2.60	2.71	5.14	5.14	2.60
F (1% point)	3.86	4.10	10.92	10.92	3.86

[1] Averages of 6 replicates.
[2] Five replicates.
[3] Four replicates.
[4] 2–12–6 on Miami, Napanee, and Thomas, and 2–16–8 on Onaway and Posen soils.
* Significantly less than control.

TABLE 5.—THE EFFECT OF BORAX APPLIED IN THE ROW ON THE YIELD OF SUGAR BEETS IN 1938

Treatment in addition to 2–12–6 fertilizer	Yield—Tons per acre Averages of five replications		
	Brookston silt loam	Napanee silt loam	Miami silt loam
No borax (control)	13.3	12.2	5.8
10 pounds borax with seed	13.9	12.0	5.4
20 pounds borax with seed	14.0	12.9	5.6
40 pounds borax with seed	13.1	10.9*	4.2
80 pounds borax with seed	8.9*	8.8*	3.0
Difference required for significance	1.23	1.21	1.00
F	26.40	16.05	12.83
F (5% point)	3.01	3.01	3.01
F (1% point)	4.77	4.77	4.77

* Significantly less than control.

TABLE 6.—THE EFFECT OF BORAX APPLIED IN THE ROW ON THE YIELD OF SUGAR BEETS IN 1939

Treatment in addtion to fertilizer[1]	Yield—Tons per acre Averages of six replicates				
	Miami silt loam	Napanee silt loam	Onaway loam	Posen loam	Thomas sandy loam
No borax (control)	7.2	13.3	6.2	9.17	14.5
10 pounds borax with seed	6.9	12.6	6.7	9.67	12.6
20 pounds borax with seed	6.2	13.0	6.3	9.13	10.9*
40 pounds borax with seed	3.3*	12.0	.....	.....	11.6*
80 pounds borax with seed	3.21*	7.8*	.....	.....	6.7*
80 pounds borax in side band	5.5*	13.0	.....	.....	13.1
Difference required for significance	1.2	2.1	0.6	2.07	2.2
F	18.8	8.69	2.82	1.36	13.43
F (5% point)	2.60	2.71	5.14	19.33	2.60
F (1% point)	3.86	4.10	10.92	99.33	3.86

* Significantly less than control.
[1] 2–12–6 on Miami, Napanee, and Thomas and 2–16–8 on Onaway and Posen soils.

TABLE 7.—THE EFFECT OF BORAX APPLIED AS A SIDE-DRESSING ON THE YIELD OF SUGAR BEETS IN 1939

Treatment in addition to 2–12–6 fertilizer	Yield—Pounds per plat Averages of six replicates	
	All beets	Normal beets
No borax (control)	43.8	10.0
9 pounds borax beside row	62.8*	23.8*
Difference required for significance	10.40	4.37
F	21.90	66.10
F (5% point)	6.61	6.61
F (1% point)	16.26	16.26

* Significantly greater than control.

TABLE 8.—THE EFFECT OF BORAX APPLIED BROADCAST ON THE OCCURRENCE OF HEART ROT IN SUGAR BEETS IN 1938

Treatment in addition to 2–12–6 fertilizer	Number of beets per 200 feet of row showing heart rot symptons Averages of four replicates	
	Miami silt loam	Napanee silt loam
No borax (control)	12.3	80.8
10 pounds borax before planting	1.0*	17.5*
20 pounds borax before planting	.3*	8.3**
40 pounds borax before planting	.3*	4.3*
80 pounds borax before planting	2.3*	2.3*
Difference required for significance	7.9	8.1
F	3.98	158.10
F (5% point)	3.26	3.26
F (1% point)	5.41	5.41

* Significantly less than control.
* Significantly less than control and 10 pounds borax.

TABLE 9.—THE EFFECT OF BORAX APPLIED IN THE ROW ON THE OCCURRENCE OF HEART ROT IN SUGAR BEETS IN 1938

Treatment in addition to 2–12–6 fertilizer	Number of beets per 200 feet of row showing heart rot symptoms Averages of five replicates	
	Miami silt loam	Napanee silt loam
No borax (control)	18.8	40.6
10 pounds borax with seed	0.6*	7.6*
20 pounds borax with seed	1.0*	5.6*
40 pounds borax with seed	0*	3.4*
80 pounds borax with seed	0*	0.8*
Difference required for significance	4.6	6.6
F	28.62	56.30
F (5% point)	3.01	3.01
F (1% point)	4.77	4.77

* Significantly less than control.

TABLE 10.—THE EFFECT OF BORAX APPLIED IN THE ROW ON THE OCCURRENCE OF HEART ROT IN SUGAR BEETS IN 1939

Treatment in addition to 2–16–8 fertilizer	Number beets per 200 feet of row showing heart rot symptoms Averages of four replicates	
	Onaway loam	Posen loam
No borax (control)	94.5	65.5
10 pounds borax with seed	6.0*	10.0*
20 pounds borax with seed	0*	3.0*
Difference required for significance	11.7	19.0
F	60.9	38.74
F (5% point)	5.14	5.14
F (1% point)	10.92	10.92

* Significantly less than control.

TABLE 11.—THE EFFECT OF HEART ROT ON THE SUCROSE CONTENT AND PURITY OF SUGAR BEETS IN 1939

Condition of beets	Percentage sucrose and purity Averages of six samples			
	Thomas sandy loam		Wisner loam	
	Sucrose	Purity	Sucrose	Purity
Normal (control)	16.40	85.4	17.87	89.75
Leaf symptoms only	14.51*	82.5	16.28*	89.18
Leaf and root symptoms	11.38*	76.4*	16.08*	89.62
Difference required for significance	1.48	3.18	0.68	1.91
F	26.81	18.80	19.10	1.13
F (5% point)	3.68	3.68	3.68	19.42
F (1% point)	6.36	6.36	6.36	99.38

* Significantly less than control.
Some of the sugar determinations were made by F. R. Bach of the Michigan Sugar Company.

Spring In Our Town

(*From page* 5)

once said after a funeral, "Shame on you for sniveling! It's not the dead we should be grieving about, the living folk need our consideration and our help." Then you look out across the wide river valley and notice how peaceful it is, and you push a pebble with your shoe like you used to burrow your big toe in the sand when they caught you in mischief. While down in the marsh beyond the white picket fence, some girls are picking cowslips throbbing with gold, and a gopher rears on his haunches to see if those oncoming boys have sling-shots handy. Why, here we are again, history repeats itself. There's nothing much different after all, either inside or outside of God's half acre.

You imagined the old town had petered out just because most of your elders had gone to bed and you had packed up and vamoosed awhile to other diggings. If that wasn't the darndest

nonsense, then I never saw or heard tell of any!

Why, this old burg has been thriving and happy ever since away before the Mexican War, over a hundred years come to think of it. What in tarnation ever made one guy think he owned it, or that its current of comfort depended on him, is a bigger puzzle than the reciprocal agreements.

So I suppose the thing to do when we get off the track about those things, when we lose our perspective and look for all our friends in the cemetery, the thing to do, I guess, is to hunt up some of the youngsters and look the new world square in the face.

FOR as I remember it, the outstanding aspect of life for us boys in Our Town was living vividly in the present and yearning avidly for the future. That is, we think of the Old Town of boyhood as a place to dream dreams and indulge in hero worship, a place to dig for angleworms, and a place to hold cloud reveries when the fish wouldn't bite.

Talking with a friend who haunted the same spots in his youth, I find his philosophy a great comfort and a guide to hopeful rather than doleful cogitation. He writes to me and says:

"As a boy to lie in reverie when the light is out, in romantic fancy to dream of Goose Pond and what might be found there at dawn. And before the break of day to tramp two miles to the shelter of the old rail fence. Thence to creep through thorns and thistles to the water's edge. To handle the new gun with care and fondness, a new single barrel, with home-loaded brass shells, four drams of black powder, more than an ounce of number four's, wads of felt and cardboard."

And in contemplative fantasy he continues, . . . "And there on the water to think as only boys can think. To talk as only boys are wont to talk. Intimately to inquire and to wonder why all this fuss over evolution and Darwin and Huxley—did God make men or man create God for himself, or what? Who would become the new prize ring champion, Paddy Ryan, Jake Kilrain, or John L. Sullivan? What chance has the dandified bank clerk of Frisco, Jim Corbett, against the Boston strong boy?

"Within the swaying boat and with nobody to tattle, one turned to the comfort of Sweet Caporal cigarettes, in each packet a prize picture of Lily Langtry, Maxine Elliott, Ada Rehan, or Lillian Russell herself in all her generous curvature. And then perhaps to recite some of the high voltage poems of Ella Wheeler Wilcox. Maybe a quick tug on the hook or a sudden flurry of Canadian geese on the wing, and a lump rises in the throat, and you plunge to the sport of boys and kings." And in conclusion, this wise friend remarks, "Only a moment to tell it, but more than a lifetime to forget!"

THAT'S why we think it saner to amble out of the graveyard and follow the Old Town juniors on their carefree rambles—if they will tolerate us. And mind you, they *will* tolerate us, if we become one of them in spirit and do it not too painfully or obviously. It will be no time now for exasperating indulgence in reminiscences, unless they relate to exciting adventures, real or fancied, which took place beside old landmarks. You may as well eschew all morbid backtracking which does not have a hero or a villain handy. Fine spun morals, wishful might-have-beens, and old fogey notions will bar you from their youthful company. Neither will it do to declare that Opportunity is greater and Education is better now than it was when *you* went barefoot.

Travel with them for a few hours and you'll find few dull moments left in Our Town. You'll abandon all thoughts of departed saints and sinners, because it will take all your concentration to follow your companions mentally, just as it bothers you considerably to keep up the pace physically.

The girls will chatter about synthetic fabrics. You'll grope in wonderment. You'll miss the old ginghams and crinolines, to listen instead to the merits, de-

fects, and comparative dress values of nylon hose, vinyon cloth, lanitol weaves, fish wool textiles, and spun glass gowns.

Some charming girl will see you are submerged and try to get you back onto firmer ground by inquiries as to your opinion of the lead artists in the latest popular motion picture, or your preferences among the jazz drummers and saxophone soloists. Again you flounder and become painfully aware how much you must have missed life while actually living it.

TURNING to the boys for greater security, you are met with all manner of unanswerable propositions and confounded anew with batting averages, ski records, stratosphere altitudes, and maybe a free-for-all quiz section on the current speed merchants like San Romani, Venzke, Fenske, Cunningham, Man-O'War, Sea Biscuit, Whichee, and Sun Beau—without your knowing one from the other. They not only make you sprint, but they take you for a ride!

(If they would only chin a bit about Dan Patch, or Strangler Lewis, or Bob Fitzsimmons, and give a look-in at Honus Wagner, or Colantha Fourth's Johanna, you might retort with some show of championship familiarity.)

They torment your shrinking ego with offhand references to their stock of common knowledge concerning Yankee clipper routes and time-tables on the Atlantic sea lanes, radio frequency modulation, mine sweepers, long-range anti-aircraft guns, or what causes sun spots and the aurora borealis.

If you carry a little kodak, they are bound to ask your opinion on film emulsions, shutter mechanisms like focal plane, compur, diomatic, kodamatic, supermatic, kodex, and kodon. If you ward them off temporarily they soon return to puzzle you about range finders, synchronizers and developers. All you really comprehend meanwhile about the whole range of this foggy business is that you should keep the sun out of your lens and push the button.

You can't escape it by motor either. The accumulated wisdom of modern youth rides the hood to analyze every knock and rattle and prescribe for every wheeze and jerk. They know every car front and rear, can recite its latest gadgets and sales talks, and give you in advance what the models of 1941 intend to be. They scan the skies and list the horsepower of every airplane by listening to its roar.

At the end of a dizzy day you wonder whether your rightful place is not alongside Loony Lucy under the w. k. weeping willow, surrounded by the other citizens whose active days are over and whose brains no longer fag and fret.

In such wise do we learn that the Old Town in Springtime is just as fabulous and fascinating a place in which to yearn and dream and ponder as it ever was in times gone by. You quit blaming your old pals for not giving you a heartier welcome with more ancient anecdotes. They're too busy keeping up with the kids!

YET even after all this sudden disheartening revelation that you have been standing still underneath a vine and fig tree that has withered away, it remains true that the basic values, the homely virtues, and the common denominators of human life are yet alive in Our Town.

This makes it all doubly satisfying when we sit back afterwards and thumb the program we got at Wilder's play. Never mind if they don't stop and moon around about old times and quaint faces. There's a new crop of times and a new crop of faces, but the game must be played the same, and the real folks are still real. Finally, judging by the weather signs, the old curtain is going to roll up again, and it won't be on the last act either.

Needs No Introduction

"Mirandy," said a friend of the family to the old colored washer-woman, "have you seen Miss Edith's fiance?"

"No ma'am," she answered, "it ain't been in the wash yet."

Joe: "We had a fifth at bridge last night."

Jim: "Don't be silly. You never had a fifth at bridge."

Joe: "Okay. Then it was a quart."

An acid spinster constituted herself O. C. Morals in a sleepy English village. One day she dropped in on Giles, a gardener noted for his joviality.

"Giles," she said, "I'm ashamed of you to set such an example, and at this crisis. Why, yesterday I saw your wheelbarrow outside the Fox and Badger for two hours!"

Giles did not say one word in reply. He left his wheelbarrow all that night outside her house.

"Say, Pete, your girl looked quite tempting in that biblical gown she wore last night."

"What do you mean, biblical gown?"

"Oh, you know, sort of lo and behold!"

Mistress: "Is my bath ready, Clara?"

Maid: "Why, this ain't Saturday."

Mistress: "How dare you? I bathe twice a day, of course. I don't want a maid as ignorant as you seem to be. Leave my employ."

Maid: "I'll go, all right. I don't want to work for anybody who needs a bath as often as you seem to."

A cute little lass approached the floor walker and asked, "Do you have notions on this floor?"

The floor walker looked her over, and then remarked: "Yes, madam, but we suppress them during business hours."

"Did your husband get hurt badly when he was hit by a car, Liza?"

"Yassuh. He suffered from conclusion of the brain."

"You mean concussion of the brain, don't you, Liza?"

"No, suh, I mean conclusion—he's daid."

The elderly maiden aunt received a letter from her ten-year-old niece: "Dear Aunt Martha: Thank you for your nice present. I have always wanted a pin-cushion, but not very much."

Planned in Advance

And then there was the gal who was going to get married and spent three months getting her torso ready.

An artist was painting in the country. A farmer came and watched him.

"Ah," said the artist, "perhaps you too are a lover of the beauties of nature. Have you seen the golden fingers of dawn spreading across the eastern sky, the red-stained, sulphurous islets floating in the lake of fire in the west, the ragged clouds at midnight, blotting out the shuddering moon?"

"No," said the farmer matter-of-factly, "not lately, I've been on the wagon for over a year."

FERTILIZER *Films* AVAILABLE

WE ARE NOW PREPARED TO LOAN without charge to agricultural colleges and experiment stations, county agricultural agents, vocational teachers, responsible farm organizations and members of the fertilizer trade, several films bearing on the proper use of fertilizers, particularly potash. *Distribution is being made from our respective branch offices as noted in the listing below, and anyone interested in showing these films should direct their requests to these offices.*

Potash in Southern Agriculture

Covers fertilization and potash deficiency symptoms of cotton, tobacco, and corn in the various States of the South. Depicts experimental work now in progress at several Experiment Stations, also crops in the field, fertilizer placement work, and scenes in a fertilizer factory.

16 mm.—sound, color—running time 20 min.

Projectors will be loaned where necessary.

Write to—American Potash Institute, Inc., Mortgage Guarantee Building, Atlanta, Georgia.

Potash From Soil to Plant

Covers testing soils to determine fertilizer needs, sampling of soils, potash deficiencies on prunes and grapes, also effects of fertilization on Ladino clover.

16 mm.—silent, color—running time 40 min. (on 1600 ft. reel).

Write to—American Potash Institute, Inc., Beans Building, San Jose, California.

Bringing Citrus Quality to Market

Shows influence of fertilizers, particularly potash, on yield and quality of citrus fruit. Quality factors include thickness of rind, volume of juice, weight and general appearance of fruit.

16 mm.—silent, color—running time 25 min. (on 800 ft. reel).

Write to—American Potash Institute, Inc., Beans Building, San Jose, California.

Machine Placement of Fertilizer

Covers methods of applying fertilizer to California orchards, lettuce, and sugar beets. Shows scenes of various types of apparatus devised by growers for applying fertilizer in orchards and on row crops.

16 mm.—silent, color—running time 15 min. (on 400 ft. reel).

Write to—American Potash Institute, Inc., Beans Building, San Jose, California.

New Soils From Old

This film was prepared for the Department of Agronomy, University of Illinois. Deals with the experimental work on Illinois Soil Experiment Fields and stresses the benefits from a balanced soil fertility program using limestone, phosphates, and potash in growing corn, wheat, clover, and other crops.

16 mm.—silent, color—running time 40 min. (on both 400 and 1600 ft. reels).

Write to—American Potash Institute, Inc., Life Building, Lafayette, Indiana. Please indicate size of reels desired.

Fertilizers Improve Midwest Crops

Shows effects of proper fertilization on the growth of corn, wheat, alfalfa, and other crops in Illinois, Indiana, and Iowa. Includes potash, phosphorus, and nitrogen starvation symptoms and their confirmation by chemical tissue tests.

16 mm.—silent, color—running time 40 min. (on both 400 and 1600 ft. reels).

Write to—American Potash Institute, Inc., Life Building, Lafayette, Indiana. Please indicate size of reels desired.

Requests for these films should include information as to group before which they are to be shown, date of exhibition, and period of time of loan.

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